Anexo 1: Simulaciones para Azotea

Se presenta las simulaciones para la azotea del centro comercial. Esta zona presenta un par MIMO del sector 1 que cubre las oficinas administrativas.

- **4G**

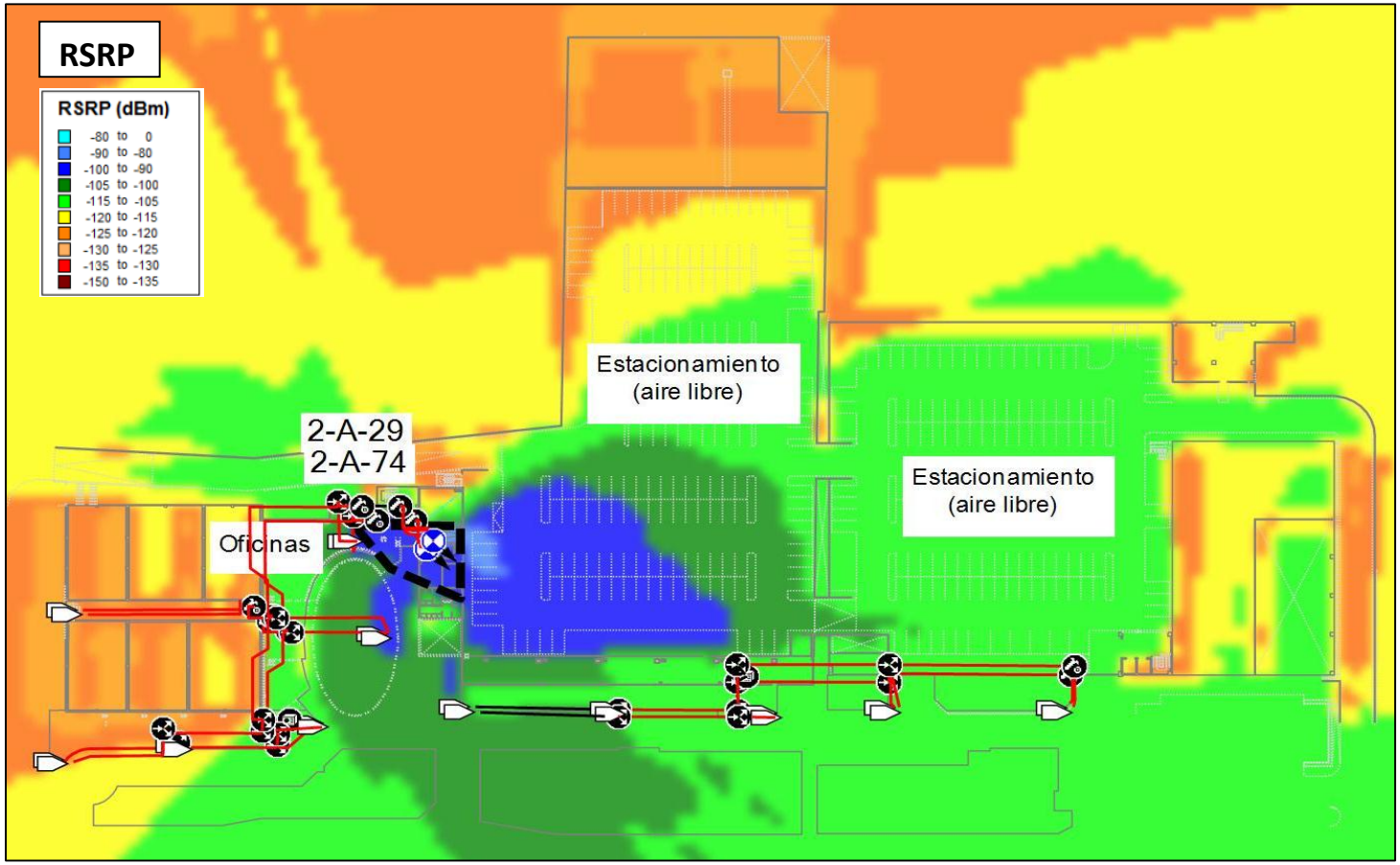


FIGURA 1-1: PREDICCIÓN DE RSRP

FUENTE: ELABORACIÓN PROPIA

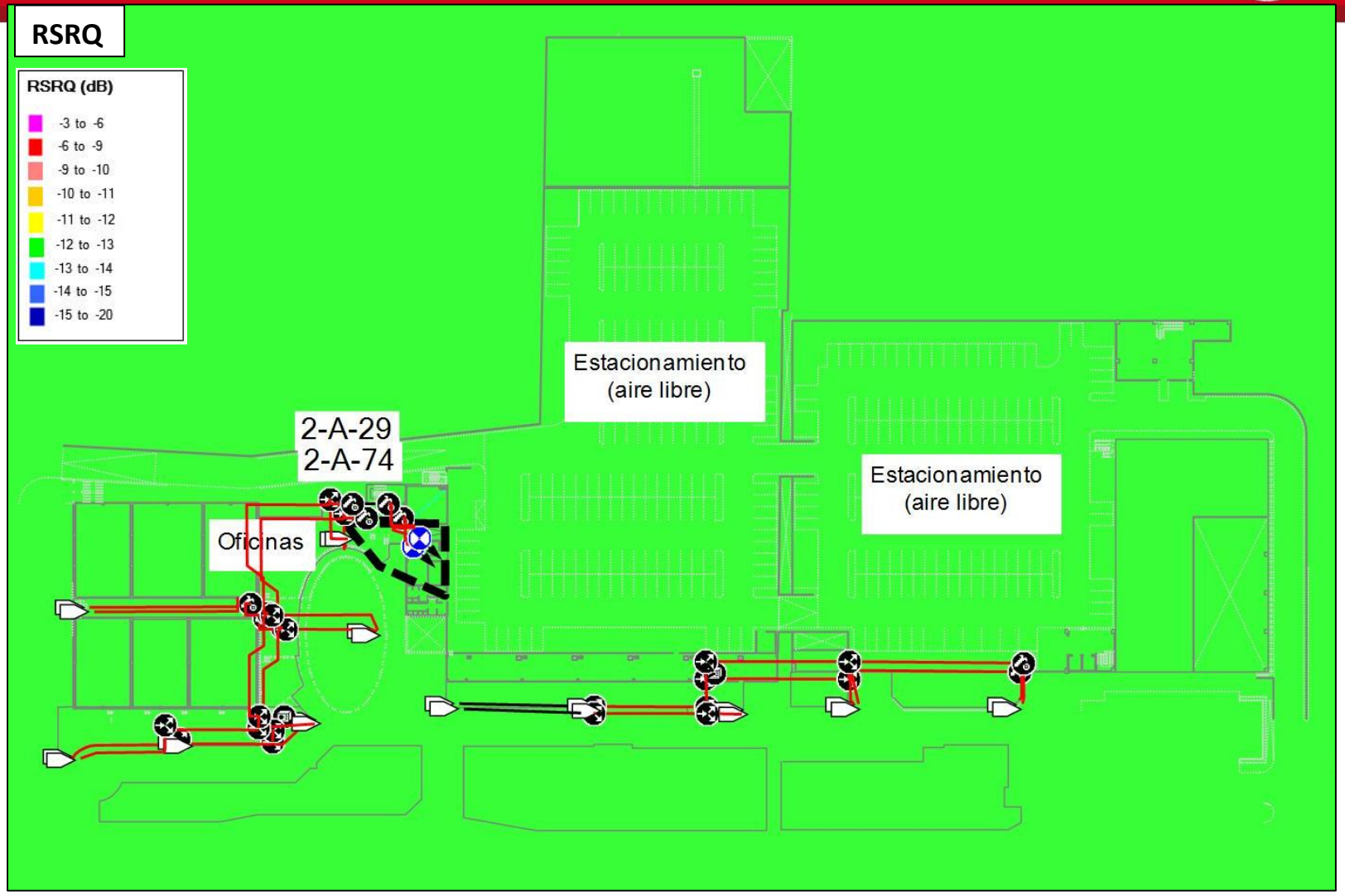


FIGURA 1-2: PREDICCIÓN DE RSRQ

FUENTE: ELABORACIÓN PROPIA

FIGURA 1-3: PREDICCIÓN DE DATA RATE

FUENTE: ELABORACIÓN PROPIA

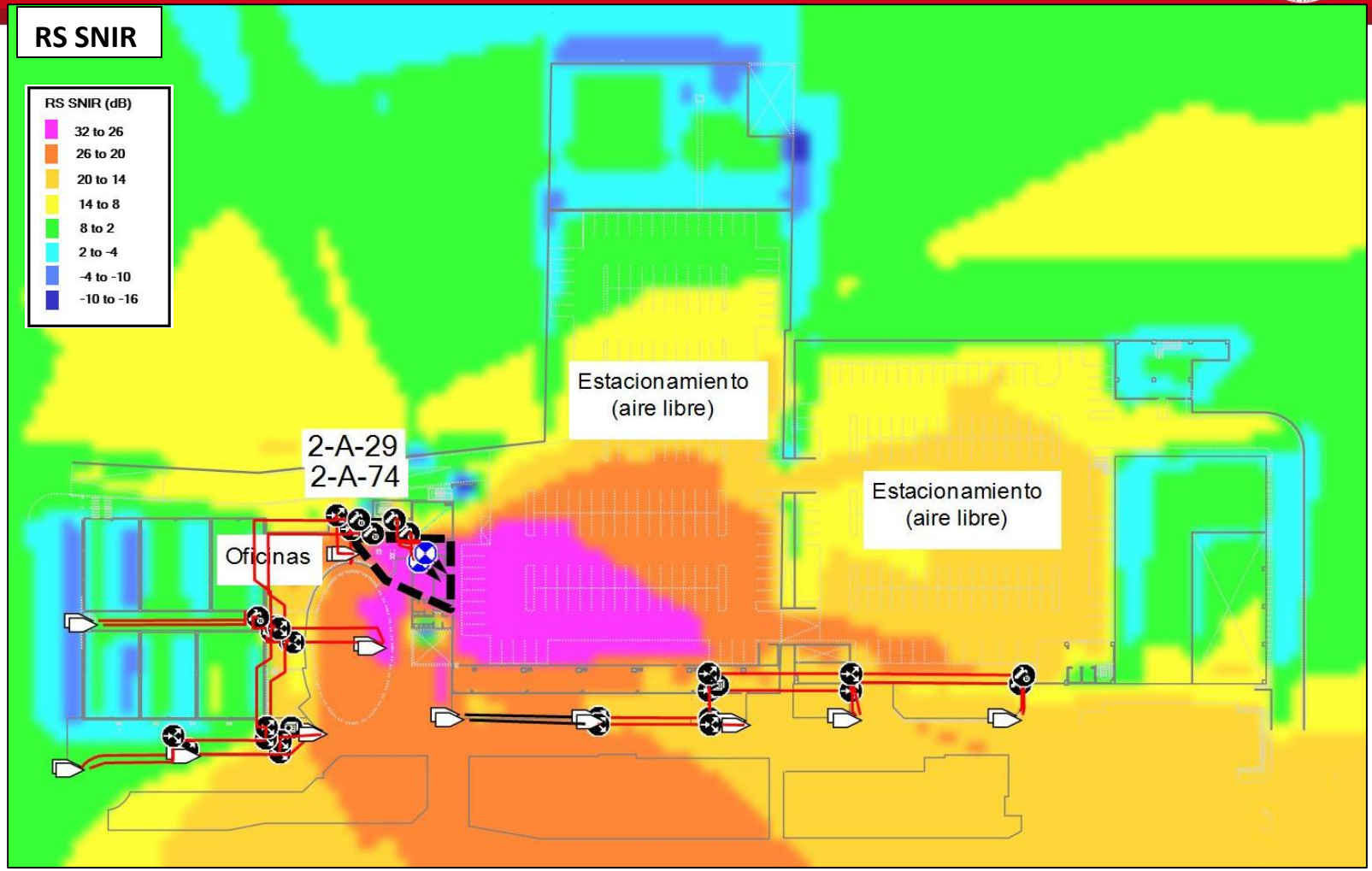


FIGURA 1-4: PREDICCIÓN DE RS SNIR

FUENTE: ELABORACIÓN PROPIA

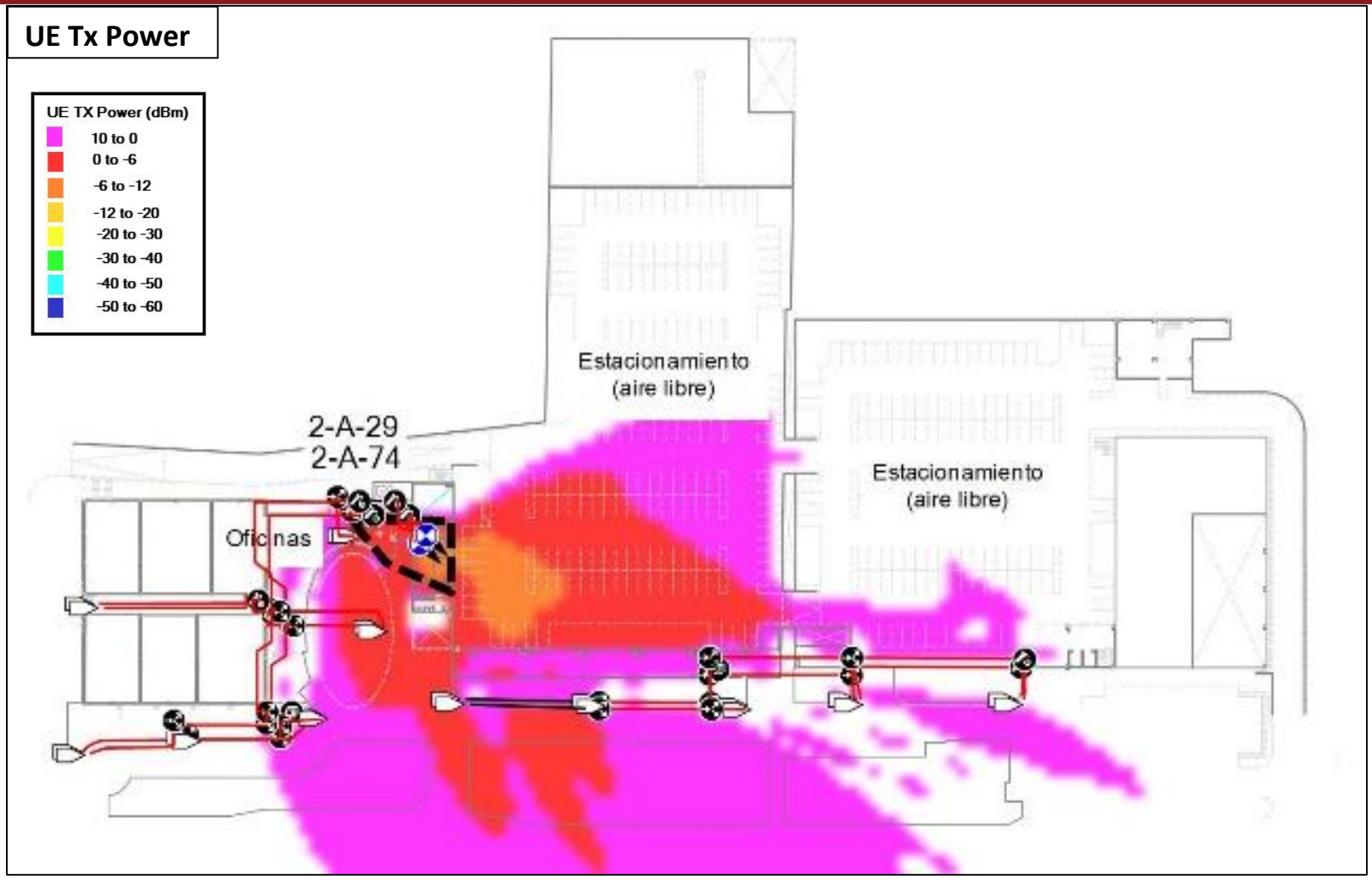


FIGURA 1-5: PREDICCIÓN DE UE TX POWER

FUENTE: ELABORACIÓN PROPIA

- **3G**

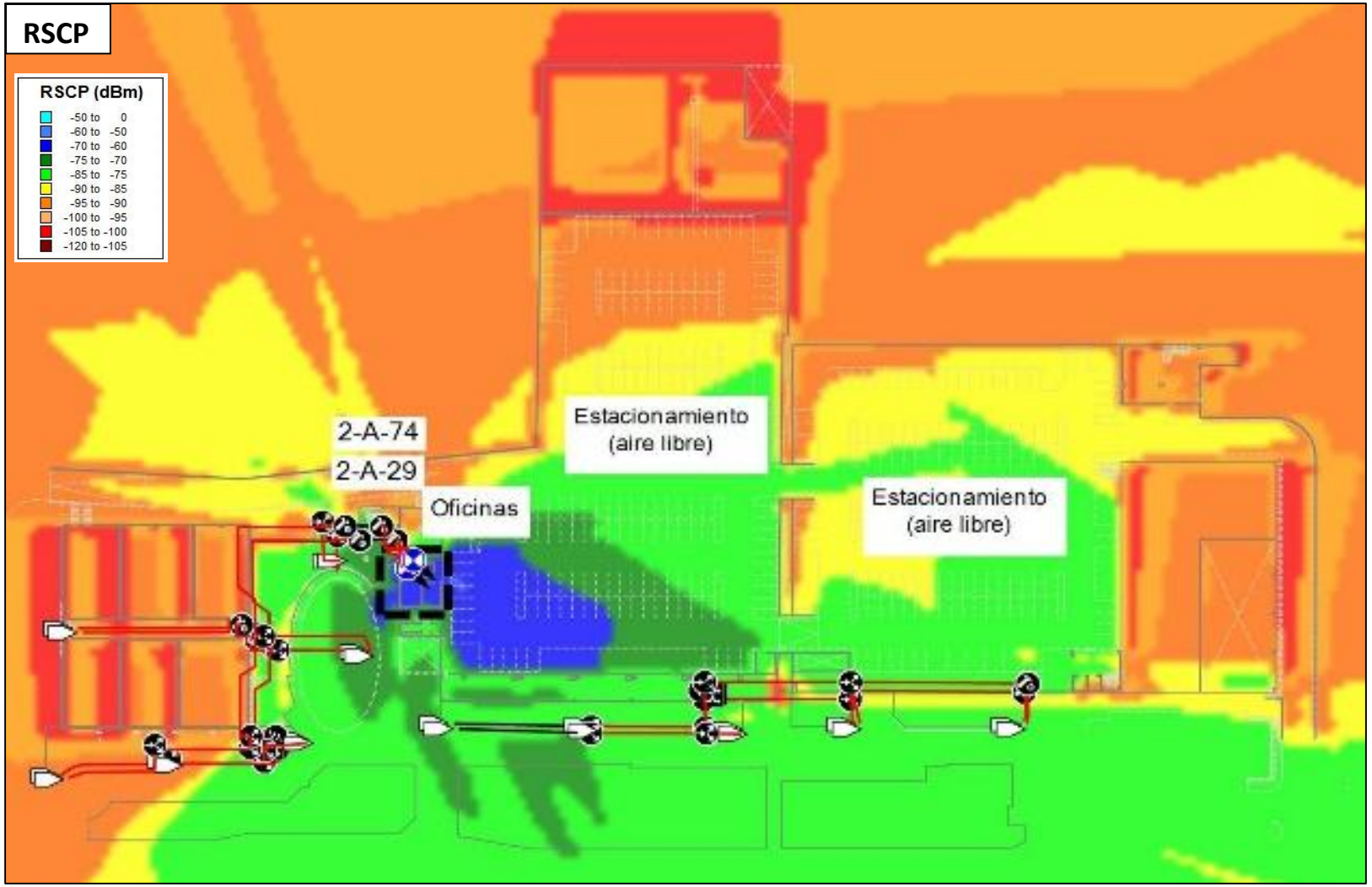


FIGURA 1-6: PREDICCIÓN DE RSCP

FUENTE: ELABORACIÓN PROPIA

- **2G**

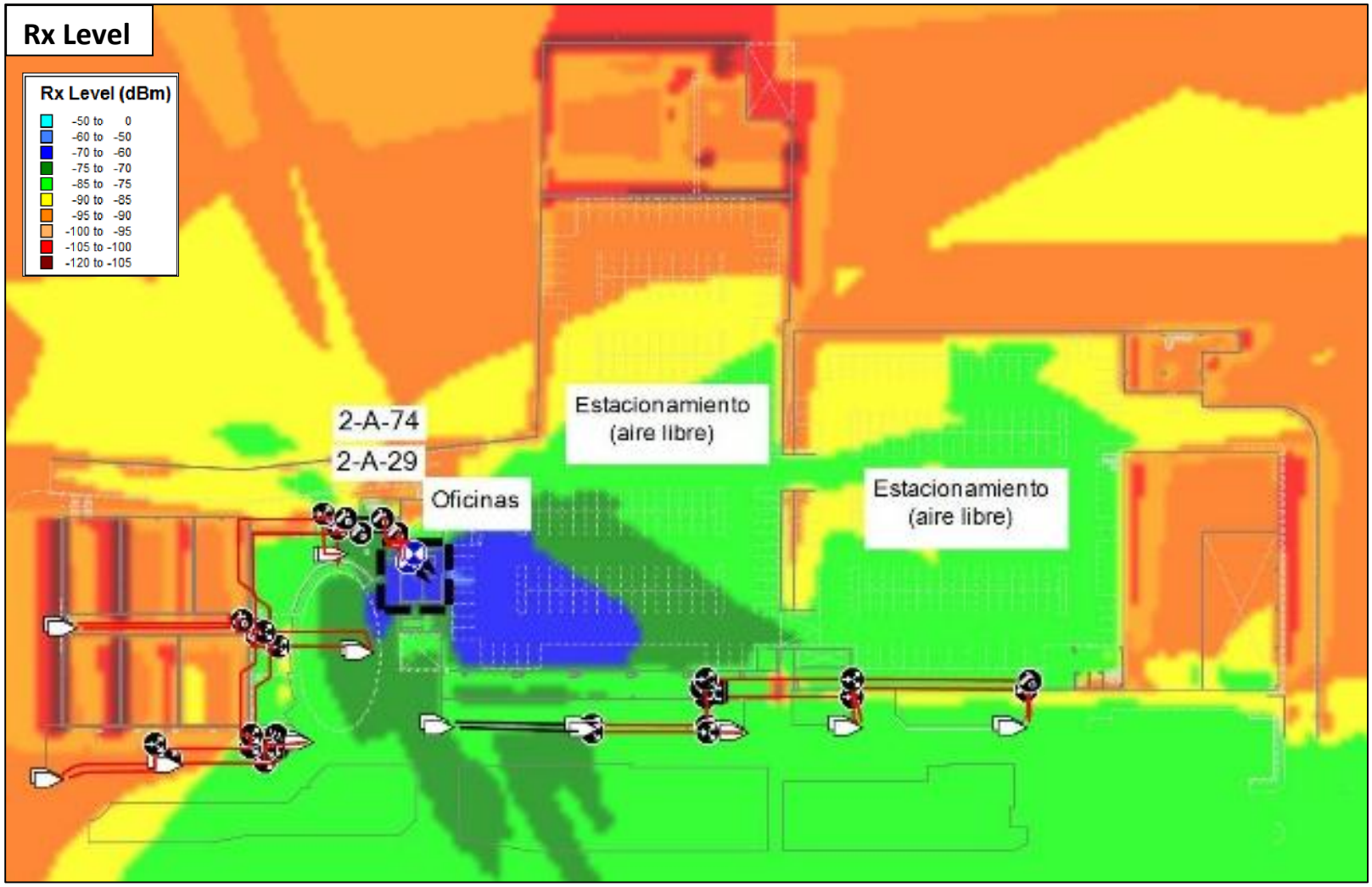


FIGURA 1-7: PREDICCIÓN DE RX LEVEL

FUENTE: ELABORACIÓN PROPIA

Se presenta la configuración de parámetros para las simulaciones de LTE, WCDMA y GSM.

- LTE

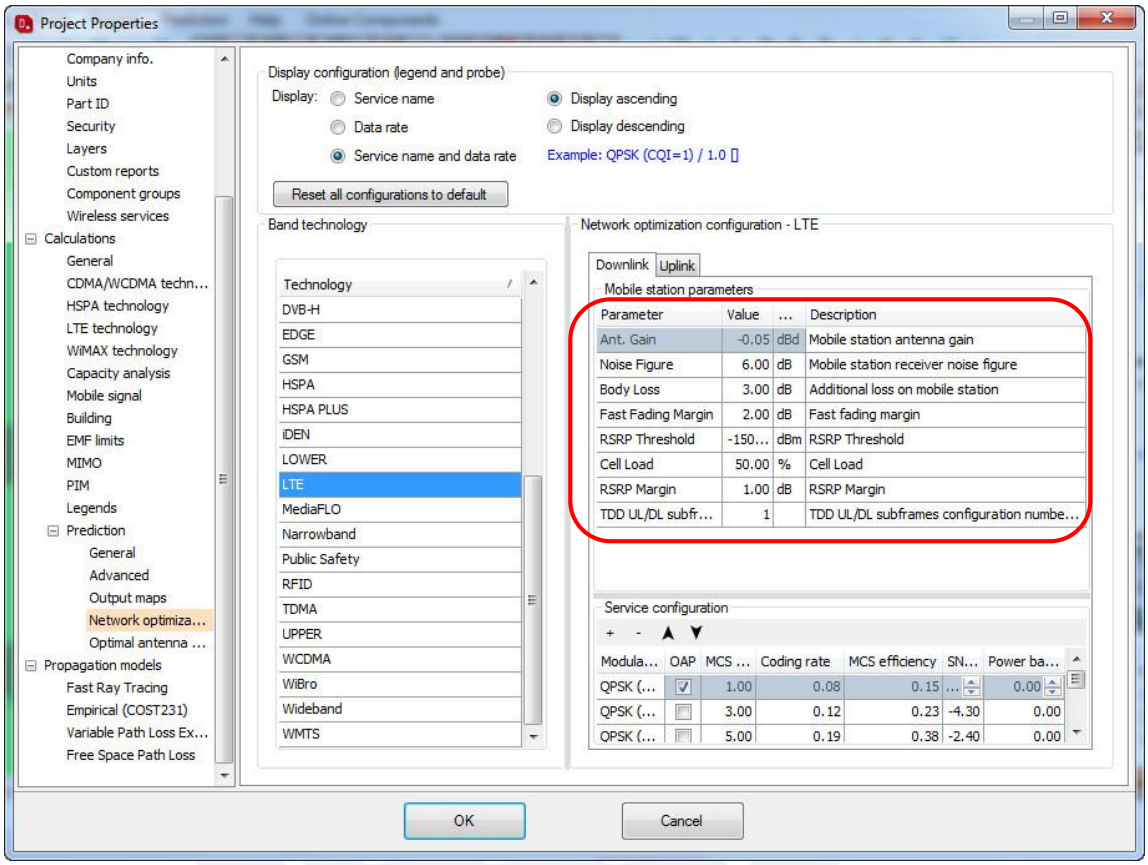


FIGURA 1-8: PARAMETROS DE LTE

FUENTE: ELABORACIÓN PROPIA

- WCDMA

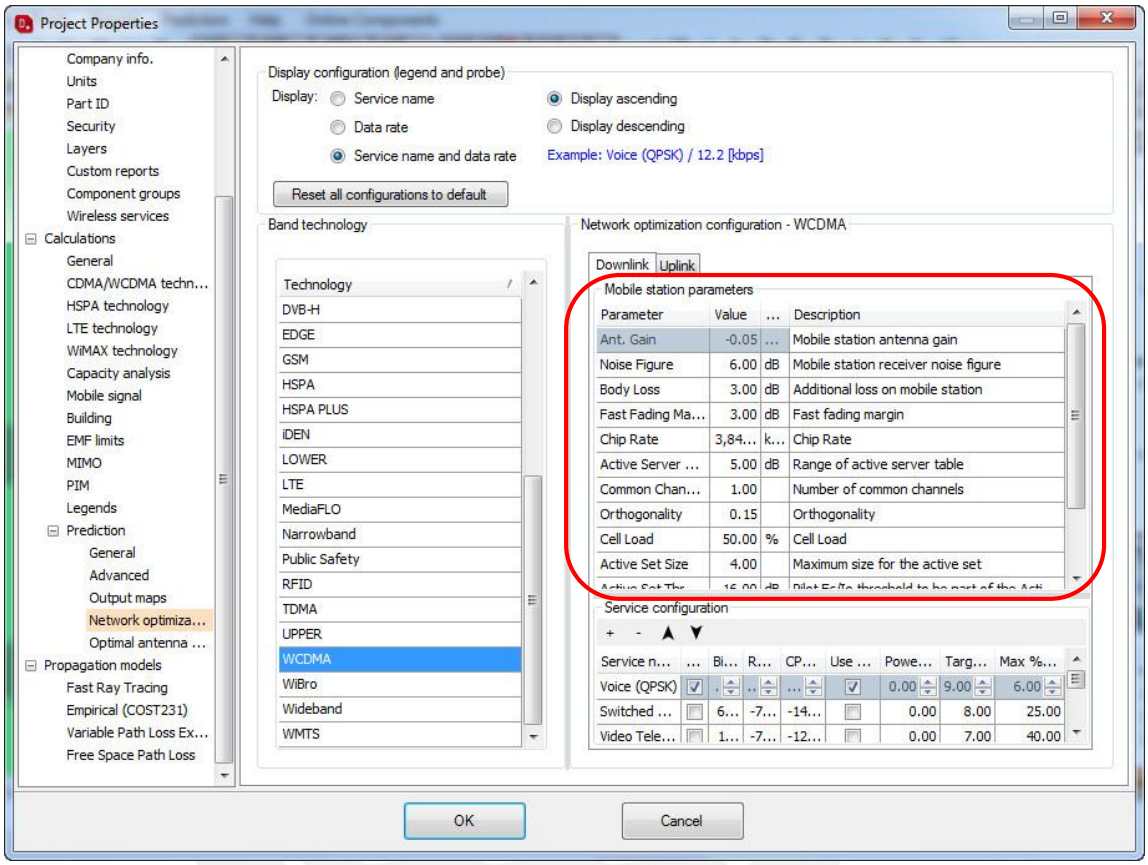


FIGURA 1-9: PARAMETROS DE WCDMA

FUENTE: ELABORACIÓN PROPIA

- GSM

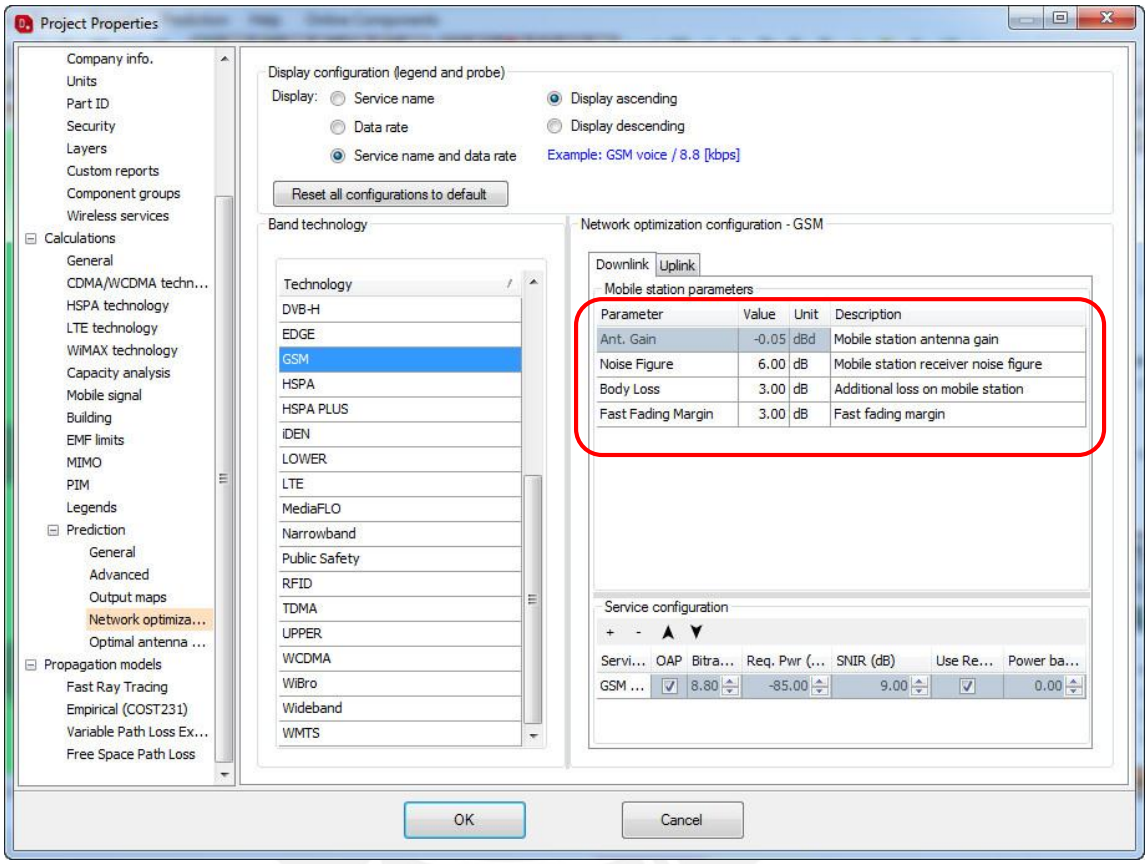


FIGURA 1-10: PARAMETROS DE GSM

FUENTE: ELABORACIÓN PROPIA

Anexo 2: Reporte de Campo Electromagnético

De acuerdo a la resolución ministerial N° 20-2005-MTC-03 se declara mediante Decreto Supremo Nº 038-2003-MTC los límites permisibles de radiación no ionizante para el área de telecomunicaciones. Se establece los siguientes límites de acuerdo a las frecuencias de trabajo para áreas de uso público:

TABLA 1-1: LÍMITES PERMISIBLES DE RADIACIÓN NO IONIZANTE
FUENTE: MINISTERIO DE TRANSPORTE Y COMUNICACIONES

Rango de frecuencias	**Intensidad de campo eléctrico (V/m)**	**Densidad de potencia (W/m^2)**
9 – 150 KHz	61.5	-
0,15 – 1 MHz	61.5	-
1 – 10 MHz	$61.5/f^{0.5}$	-
10 – 400 MHz	20	1
400 – 2000 MHz	$0.972f^{0.5}$	f/200
2 – 300 GHz	43.1	10

A continuación se presentan los niveles de radiación de las antenas del proyecto. Por último, se evalúa si estos niveles están dentro del rango permitido considerando una distancia de 40cm.

TABLA 1-2: CAMPO ELECTROMAGNÉTICO

FUENTE: ELABORACIÓN PROPIA

Antena ID	Sistema ID	Composite power		Densidad de potencia	Intensidad de campo eléctrico	Distancia	Nivel de potencia	Resultado
		Antes ant. (dBm)	Despues ant. (EiRP) (dBm)	(W/Sq. m)	(V/m)	(cm)	(%)	(40.00 cm)
1-A-0	2100 MHz - AWS - LTE	6.53	9.53	0.35	11.44	4.54	3.52%	-
1-A-0	1900 MHz - PCS - WCDMA	20.40	23.40	8.47	56.51	4.54	85.75%	-
1-A-0	1900 MHz - PCS - GSM	11.38	14.38	1.06	19.99	4.54	10.73%	-
1-A-0	All systems	21.07	24.07	0.00	0.00	4.54	100.00%	Pasa
1-A-1	2100 MHz - AWS - LTE	4.70	12.70	0.35	11.53	6.48	3.57%	-
1-A-1	1900 MHz - PCS - WCDMA	18.50	26.50	8.47	56.50	6.48	85.70%	-
1-A-1	1900 MHz - PCS - GSM	9.47	17.47	1.06	19.98	6.48	10.72%	-
1-A-1	All systems	19.17	27.17	0.00	0.00	6.48	100.00%	Pasa
1-A-2	2100 MHz - AWS - LTE	5.17	13.17	0.35	11.47	6.88	3.54%	-
1-A-2	1900 MHz - PCS - WCDMA	19.02	27.02	8.47	56.51	6.88	85.74%	-
1-A-2	1900 MHz - PCS - GSM	9.99	17.99	1.06	19.99	6.88	10.73%	-
1-A-2	All systems	19.69	27.69	0.00	0.00	6.88	100.00%	Pasa
1-A-3	2100 MHz - AWS - LTE	6.81	14.81	0.36	11.67	8.16	3.66%	-

1-A-3	1900 MHz - PCS - WCDMA	20.50	28.50	8.46	56.47	8.16	85.63%	-
1-A-3	1900 MHz - PCS - GSM	11.47	19.47	1.06	19.98	8.16	10.71%	-
1-A-3	All systems	21.18	29.18	0.00	0.00	8.16	100.00%	Pasa
1-A-4	2100 MHz - AWS - LTE	7.54	15.54	0.36	11.58	8.95	3.60%	-
1-A-4	1900 MHz - PCS - WCDMA	21.30	29.30	8.46	56.49	8.95	85.68%	-
1-A-4	1900 MHz - PCS - GSM	12.28	20.28	1.06	19.98	8.95	10.72%	-
1-A-4	All systems	21.97	29.97	0.00	0.00	8.95	100.00%	Pasa
1-A-5	2100 MHz - AWS - LTE	4.12	7.12	0.40	12.27	3.20	4.04%	-
1-A-5	1900 MHz - PCS - WCDMA	17.36	20.36	8.43	56.36	3.20	85.29%	-
1-A-5	1900 MHz - PCS - GSM	8.34	11.34	1.05	19.93	3.20	10.67%	-
1-A-5	All systems	18.05	21.05	0.00	0.00	3.20	100.00%	Pasa
1-A-6	2100 MHz - AWS - LTE	8.85	16.85	0.42	12.57	9.58	4.25%	-
1-A-6	1900 MHz - PCS - WCDMA	21.87	29.87	8.41	56.30	9.58	85.11%	-
1-A-6	1900 MHz - PCS - GSM	12.84	20.84	1.05	19.91	9.58	10.64%	-
1-A-6	All systems	22.57	30.57	0.00	0.00	9.58	100.00%	Pasa
1-A-7	2100 MHz - AWS - LTE	8.46	16.46	0.42	12.57	9.16	4.25%	-
1-A-7	1900 MHz - PCS - WCDMA	21.48	29.48	8.41	56.30	9.16	85.11%	-

1-A-7	1900 MHz - PCS - GSM	12.45	20.45	1.05	19.91	9.16	10.64%	-
1-A-7	All systems	22.18	30.18	0.00	0.00	9.16	100.00%	Pasa
1-A-8	2100 MHz - AWS - LTE	5.58	13.58	0.39	12.15	6.80	3.97%	-
1-A-8	1900 MHz - PCS - WCDMA	18.91	26.91	8.43	56.38	6.80	85.36%	-
1-A-8	1900 MHz - PCS - GSM	9.88	17.88	1.05	19.94	6.80	10.68%	-
1-A-8	All systems	19.59	27.59	0.00	0.00	6.80	100.00%	Pasa
1-A-9	2100 MHz - AWS - LTE	2.80	10.80	0.39	12.18	4.93	3.98%	-
1-A-9	1900 MHz - PCS - WCDMA	16.12	24.12	8.43	56.38	4.93	85.34%	-
1-A-9	1900 MHz - PCS - GSM	7.09	15.09	1.05	19.94	4.93	10.67%	-
1-A-9	All systems	16.80	24.80	0.00	0.00	4.93	100.00%	Pasa
1-A-10	2100 MHz - AWS - LTE	5.45	13.45	0.39	12.14	6.71	3.96%	-
1-A-10	1900 MHz - PCS - WCDMA	18.79	26.79	8.43	56.38	6.71	85.36%	-
1-A-10	1900 MHz - PCS - GSM	9.76	17.76	1.05	19.94	6.71	10.68%	-
1-A-10	All systems	19.47	27.47	0.00	0.00	6.71	100.00%	Pasa
1-A-11	2100 MHz - AWS - LTE	5.65	13.65	0.39	12.16	6.86	3.97%	-
1-A-11	1900 MHz - PCS - WCDMA	18.98	26.98	8.43	56.38	6.86	85.35%	-
1-A-11	1900 MHz - PCS - GSM	9.95	17.95	1.05	19.94	6.86	10.68%	-
1-A-11	All systems	19.67	27.67	0.00	0.00	6.86	100.00%	Pasa

1-A-12	2100 MHz - AWS - LTE	6.99	14.99	0.40	12.28	7.92	4.05%	-
1-A-12	1900 MHz - PCS - WCDMA	20.22	28.22	8.43	56.36	7.92	85.28%	-
1-A-12	1900 MHz - PCS - GSM	11.19	19.19	1.05	19.93	7.92	10.67%	-
1-A-12	All systems	20.91	28.91	0.00	0.00	7.92	100.00%	Pasa
1-A-13	2100 MHz - AWS - LTE	3.86	11.86	0.33	11.13	6.10	3.33%	-
1-A-13	1900 MHz - PCS - WCDMA	17.98	25.98	8.49	56.57	6.10	85.92%	-
1-A-13	1900 MHz - PCS - GSM	8.96	16.96	1.06	20.01	6.10	10.75%	-
1-A-13	All systems	18.64	26.64	0.00	0.00	6.10	100.00%	Pasa
1-A-14	2100 MHz - AWS - LTE	7.00	15.00	0.34	11.33	8.59	3.45%	-
1-A-14	1900 MHz - PCS - WCDMA	20.96	28.96	8.48	56.53	8.59	85.81%	-
1-A-14	1900 MHz - PCS - GSM	11.93	19.93	1.06	20.00	8.59	10.74%	-
1-A-14	All systems	21.62	29.62	0.00	0.00	8.59	100.00%	Pasa
1-A-15	2100 MHz - AWS - LTE	7.90	15.90	0.95	18.95	5.70	9.65%	-
1-A-15	1900 MHz - PCS - WCDMA	16.64	24.64	7.13	51.85	5.70	72.18%	-
1-A-15	1900 MHz - PCS - GSM	10.65	18.65	1.80	26.02	5.70	18.17%	-
1-A-15	All systems	18.06	26.06	0.00	0.00	5.70	100.00%	Pasa
1-A-16	2100 MHz - AWS - LTE	10.39	18.39	0.98	19.21	7.49	9.91%	-

1-A-16	1900 MHz - PCS - WCDMA	19.00	27.00	7.11	51.77	7.49	71.97%	-
1-A-16	1900 MHz - PCS - GSM	13.01	21.01	1.79	25.98	7.49	18.12%	-
1-A-16	All systems	20.43	28.43	0.00	0.00	7.49	100.00%	Pasa
1-A-17	2100 MHz - AWS - LTE	9.53	17.53	1.00	19.38	6.72	10.10%	-
1-A-17	1900 MHz - PCS - WCDMA	18.05	26.05	7.10	51.72	6.72	71.82%	-
1-A-17	1900 MHz - PCS - GSM	12.07	20.07	1.79	25.95	6.72	18.08%	-
1-A-17	All systems	19.49	27.49	0.00	0.00	6.72	100.00%	Pasa
1-A-18	2100 MHz - AWS - LTE	10.43	18.43	0.91	18.56	7.79	9.25%	-
1-A-18	1900 MHz - PCS - WCDMA	19.38	27.38	7.16	51.96	7.79	72.49%	-
1-A-18	1900 MHz - PCS - GSM	13.39	21.39	1.80	26.07	7.79	18.25%	-
1-A-18	All systems	20.77	28.77	0.00	0.00	7.79	100.00%	Pasa
1-A-19	2100 MHz - AWS - LTE	7.71	15.71	0.95	18.89	5.60	9.59%	-
1-A-19	1900 MHz - PCS - WCDMA	16.49	24.49	7.14	51.86	5.60	72.22%	-
1-A-19	1900 MHz - PCS - GSM	10.50	18.50	1.80	26.02	5.60	18.18%	-
1-A-19	All systems	17.90	25.90	0.00	0.00	5.60	100.00%	Pasa
1-A-20	2100 MHz - AWS - LTE	10.13	18.13	0.86	17.98	7.77	8.68%	-
1-A-20	1900 MHz - PCS - WCDMA	19.37	27.37	7.20	52.11	7.77	72.92%	-

1-A-20	1900 MHz - PCS - GSM	13.39	21.39	1.82	26.18	7.77	18.40%	-
1-A-20	All systems	20.75	28.75	0.00	0.00	7.77	100.00%	Pasa
1-A-21	2100 MHz - AWS - LTE	8.93	16.93	0.90	18.44	6.60	9.14%	-
1-A-21	1900 MHz - PCS - WCDMA	17.93	25.93	7.17	51.98	6.60	72.55%	-
1-A-21	1900 MHz - PCS - GSM	11.95	19.95	1.81	26.11	6.60	18.30%	-
1-A-21	All systems	19.33	27.33	0.00	0.00	6.60	100.00%	Pasa
1-A-22	2100 MHz - AWS - LTE	8.82	16.82	0.92	18.61	6.45	9.31%	-
1-A-22	1900 MHz - PCS - WCDMA	17.73	25.73	7.15	51.93	6.45	72.42%	-
1-A-22	1900 MHz - PCS - GSM	11.75	19.75	1.80	26.09	6.45	18.27%	-
1-A-22	All systems	19.13	27.13	0.00	0.00	6.45	100.00%	Pasa
1-A-23	2100 MHz - AWS - LTE	10.06	18.06	0.90	18.40	7.53	9.09%	-
1-A-23	1900 MHz - PCS - WCDMA	19.08	27.08	7.17	52.00	7.53	72.59%	-
1-A-23	1900 MHz - PCS - GSM	13.10	21.10	1.81	26.12	7.53	18.31%	-
1-A-23	All systems	20.47	28.47	0.00	0.00	7.53	100.00%	Pasa
1-A-24	2100 MHz - AWS - LTE	10.96	18.96	0.86	17.99	8.54	8.70%	-
1-A-24	1900 MHz - PCS - WCDMA	20.20	28.20	7.20	52.11	8.54	72.91%	-
1-A-24	1900 MHz - PCS - GSM	14.22	22.22	1.82	26.17	8.54	18.39%	-
1-A-24	All systems	21.57	29.57	0.00	0.00	8.54	100.00%	Pasa

1-A-25	2100 MHz - AWS - LTE -	2.85	10.85	0.91	18.50	3.27	9.20%	-
1-A-25	1900 MHz - PCS - WCDMA	11.82	19.82	7.17	51.98	3.27	72.54%	-
1-A-25	1900 MHz - PCS - GSM	5.83	13.83	1.80	26.08	3.27	18.26%	-
1-A-25	All systems	13.22	21.22	0.00	0.00	3.27	100.00%	Pasa
1-A-26	2100 MHz - AWS - LTE	4.94	12.94	0.34	11.33	6.78	3.45%	-
1-A-26	1900 MHz - PCS - WCDMA	18.90	26.90	8.48	56.53	6.78	85.81%	-
1-A-26	1900 MHz - PCS - GSM	9.87	17.87	1.06	20.00	6.78	10.74%	-
1-A-26	All systems	19.56	27.56	0.00	0.00	6.78	100.00%	Pasa
1-A-27	2100 MHz - AWS - LTE	4.47	7.47	0.34	11.30	3.62	3.43%	-
1-A-27	1900 MHz - PCS - WCDMA	18.45	21.45	8.48	56.54	3.62	85.83%	-
1-A-27	1900 MHz - PCS - GSM	9.43	12.43	1.06	20.00	3.62	10.74%	-
1-A-27	All systems	19.12	22.12	0.00	0.00	3.62	100.00%	Pasa
1-A-28	2100 MHz - AWS - LTE	3.39	6.39	0.33	11.23	3.22	3.39%	-
1-A-28	1900 MHz - PCS - WCDMA	17.43	20.43	8.48	56.55	3.22	85.87%	-
1-A-28	1900 MHz - PCS - GSM	8.40	11.40	1.06	20.00	3.22	10.74%	-
1-A-28	All systems	18.09	21.09	0.00	0.00	3.22	100.00%	Pasa
1-A-30	2100 MHz - AWS - LTE	4.99	7.99	9.87	61.00	0.71	100.00%	-
1-A-30	All systems	4.99	7.99	0.00	0.00	0.71	100.00%	Pasa

1-A-31	2100 MHz - AWS - LTE	9.72	17.72	9.87	61.00	2.18	100.00%	-
1-A-31	All systems	9.72	17.72	0.00	0.00	2.18	100.00%	Pasa
1-A-32	2100 MHz - AWS - LTE	9.33	17.33	9.87	61.00	2.09	100.00%	-
1-A-32	All systems	9.33	17.33	0.00	0.00	2.09	100.00%	Pasa
1-A-33	2100 MHz - AWS - LTE	6.45	14.45	9.87	61.00	1.50	100.00%	-
1-A-33	All systems	6.45	14.45	0.00	0.00	1.50	100.00%	Pasa
1-A-34	2100 MHz - AWS - LTE	3.67	11.67	9.87	61.00	1.09	100.00%	-
1-A-34	All systems	3.67	11.67	0.00	0.00	1.09	100.00%	Pasa
1-A-35	2100 MHz - AWS - LTE	6.32	14.32	9.87	61.00	1.48	100.00%	-
1-A-35	All systems	6.32	14.32	0.00	0.00	1.48	100.00%	Pasa
1-A-36	2100 MHz - AWS - LTE	6.45	14.45	9.87	61.00	1.50	100.00%	-
1-A-36	All systems	6.45	14.45	0.00	0.00	1.50	100.00%	Pasa
1-A-37	2100 MHz - AWS - LTE	7.86	15.86	9.87	61.00	1.76	100.00%	-
1-A-37	All systems	7.86	15.86	0.00	0.00	1.76	100.00%	Pasa
1-A-48	2100 MHz - AWS - LTE	7.09	10.09	9.87	61.00	0.91	100.00%	-
1-A-48	All systems	7.09	10.09	0.00	0.00	0.91	100.00%	Pasa
1-A-49	2100 MHz - AWS - LTE	5.25	13.25	9.87	61.00	1.31	100.00%	-
1-A-49	All systems	5.25	13.25	0.00	0.00	1.31	100.00%	Pasa
1-A-50	2100 MHz - AWS - LTE	5.73	13.73	9.87	61.00	1.38	100.00%	-
1-A-50	All systems	5.73	13.73	0.00	0.00	1.38	100.00%	Pasa
1-A-51	2100 MHz - AWS - LTE	7.37	15.37	9.87	61.00	1.67	100.00%	-
1-A-51	All systems	7.37	15.37	0.00	0.00	1.67	100.00%	Pasa

1-A-52	2100 MHz - AWS - LTE	8.10	16.10	9.87	61.00	1.81	100.00%	-
1-A-52	All systems	8.10	16.10	0.00	0.00	1.81	100.00%	Pasa
1-A-53	2100 MHz - AWS - LTE	4.42	12.42	9.87	61.00	1.19	100.00%	-
1-A-53	All systems	4.42	12.42	0.00	0.00	1.19	100.00%	Pasa
1-A-54	2100 MHz - AWS - LTE	7.56	15.56	9.87	61.00	1.70	100.00%	-
1-A-54	All systems	7.56	15.56	0.00	0.00	1.70	100.00%	Pasa
1-A-55	2100 MHz - AWS - LTE	5.50	13.50	9.87	61.00	1.34	100.00%	-
1-A-55	All systems	5.50	13.50	0.00	0.00	1.34	100.00%	Pasa
1-A-56	2100 MHz - AWS - LTE	5.02	8.02	9.87	61.00	0.72	100.00%	-
1-A-56	All systems	5.02	8.02	0.00	0.00	0.72	100.00%	Pasa
1-A-57	2100 MHz - AWS - LTE	3.94	6.94	9.87	61.00	0.63	100.00%	-
1-A-57	All systems	3.94	6.94	0.00	0.00	0.63	100.00%	Pasa
1-A-58	2100 MHz - AWS - LTE	7.41	15.41	9.87	61.00	1.67	100.00%	-
1-A-58	All systems	7.41	15.41	0.00	0.00	1.67	100.00%	Pasa
1-A-59	2100 MHz - AWS - LTE	8.08	16.08	9.87	61.00	1.81	100.00%	-
1-A-59	All systems	8.08	16.08	0.00	0.00	1.81	100.00%	Pasa
1-A-60	2100 MHz - AWS - LTE	8.63	16.63	9.87	61.00	1.93	100.00%	-
1-A-60	All systems	8.63	16.63	0.00	0.00	1.93	100.00%	Pasa
1-A-61	2100 MHz - AWS - LTE	9.22	17.22	9.87	61.00	2.06	100.00%	-
1-A-61	All systems	9.22	17.22	0.00	0.00	2.06	100.00%	Pasa
1-A-62	2100 MHz - AWS - LTE	6.55	14.55	9.87	61.00	1.52	100.00%	-
1-A-62	All systems	6.55	14.55	0.00	0.00	1.52	100.00%	Pasa

1-A-73	2100 MHz - AWS - LTE	3.99	11.99	9.87	61.00	1.13	100.00%	-
1-A-73	All systems	3.99	11.99	0.00	0.00	1.13	100.00%	Pasa
1-A-75	2100 MHz - AWS - LTE	8.14	16.14	9.87	61.00	1.82	100.00%	-
1-A-75	All systems	8.14	16.14	0.00	0.00	1.82	100.00%	Pasa
1-A-76	2100 MHz - AWS - LTE	7.83	15.83	9.87	61.00	1.76	100.00%	-
1-A-76	All systems	7.83	15.83	0.00	0.00	1.76	100.00%	Pasa
1-A-77	2100 MHz - AWS - LTE	8.71	16.71	9.87	61.00	1.95	100.00%	-
1-A-77	All systems	8.71	16.71	0.00	0.00	1.95	100.00%	Pasa
1-A-78	2100 MHz - AWS - LTE	10.44	18.44	9.87	61.00	2.37	100.00%	-
1-A-78	All systems	10.44	18.44	0.00	0.00	2.37	100.00%	Pasa
1-A-79	2100 MHz - AWS - LTE	10.75	18.75	9.87	61.00	2.46	100.00%	-
1-A-79	All systems	10.75	18.75	0.00	0.00	2.46	100.00%	Pasa
2-A-29	2100 MHz - AWS - LTE	5.60	13.60	0.88	18.18	4.56	8.89%	-
2-A-29	1900 MHz - PCS - WCDMA	14.74	22.74	7.19	52.07	4.56	72.79%	-
2-A-29	1900 MHz - PCS - GSM - Sector N/A	8.75	16.75	1.81	26.13	4.56	18.33%	-
2-A-29	All systems	16.12	24.12	0.00	0.00	4.56	100.00%	Pasa
2-A-74	2100 MHz - AWS - LTE	5.44	13.44	9.87	61.00	1.33	100.00%	-
2-A-74	All systems	5.44	13.44	0.00	0.00	1.33	100.00%	Pasa

En resumen se obtiene los siguientes máximos valores para cada tecnología:

TABLA 1-3: RESÚMEN

FUENTE: ELABORACIÓN PROPIA

	Frecuencia (MHz)	Antena	Densidad de potencia máxima(W/m^2)	Densidad de potencia máxima según normativa (W/m^2)	Resultado
3G	1900	1-A-13	8.49	9.5	**PASA**
2G	1900	1-A-20	1.82	9.5	**PASA**
4G	2100	1-A-30	9.87	10	**PASA**

Se concluye que el 100% de las antenas del proyecto presentan niveles de radiación dentro del rango permisible por el estado.

Anexo 3: Reporte de Link Budget

Se presentan los cálculos de link Budget para cada antena, cabe recordar que el modelo de propagación usado en el proyecto es el Fast Ray Tracing.

TABLA 1-1: LINK BUDGET

FUENTE: ELABORACIÓN PROPIA

Antena ID	System ID	Coupler		Splitter	Cable	Otros	Summary						
		Thru Loss	Tap Loss	Loss			Res Blck Pwr	Sis Out Power		Total DAS Gain/Loss	Gan. Antena	Antena ERP	
								Piloto	Total			Pilot	Pwr por Ch.
		Subtotal (dB)	Subtotal (dB)	Subtotal (dB)	Subtotal (dB)	Subtotal (dB)	(dBm)	(dBm)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)
1-A-0	1900 MHz - PCS - GSM	-3.8	-7.7	-3.2	-10.74	-0.2			31	-25.64	0.85		6.21
	1900 MHz - PCS - WCDMA	-3.8	-7.7	-3.2	-10.7	-0.2		33	43	-25.61	0.85	8.24	18.24
	2100 MHz - AWS - LTE	-3.8	-7.7		-10.78	-0.2	9		29	-22.47	0.85		7.38
1-A-1	1900 MHz - PCS - GSM	-1.7	-10.7	-6.5	-8.45	-0.2			31	-27.55	5.85		9.3
	1900 MHz - PCS - WCDMA	-1.7	-10.7	-6.5	-8.41	-0.2		33	43	-27.51	5.85	11.34	21.34
	2100 MHz - AWS - LTE	-1.7	-10.7	-3.3	-8.4	-0.2	9		29	-24.3	5.85		10.55
1-A-2	1900 MHz - PCS - GSM	-3.1	-10.7	-3.2	-9.82	-0.2			31	-27.03	5.85		9.82
	1900 MHz - PCS - WCDMA	-3.1	-10.7	-3.2	-9.78	-0.2		33	43	-26.99	5.85	11.86	21.86
	2100 MHz - AWS - LTE	-3.1	-10.7		-9.83	-0.2	9		29	-23.83	5.85		11.02
1-A-3	1900 MHz - PCS - GSM	-1.7	-10.7	-6.5	-6.44	-0.2			31	-25.55	5.85		11.3

	1900 MHz - PCS - WCDMA	-1.7	-10.7	-6.5	-6.4	-0.2		33	43	-25.51	5.85	13.34	23.34
	2100 MHz - AWS - LTE	-1.7	-10.7	-3.3	-6.29	-0.2	9		29	-22.19	5.85		12.66
1-A-4	1900 MHz - PCS - GSM	-2.4	-10.7	-3.2	-8.24	-0.2			31	-24.74	5.85		12.11
	1900 MHz - PCS - WCDMA	-2.4	-10.7	-3.2	-8.2	-0.2		33	43	-24.71	5.85	14.14	24.14
	2100 MHz - AWS - LTE	-2.4	-10.7		-8.16	-0.2	9		29	-21.46	5.85		13.39
1-A-5	1900 MHz - PCS - GSM		-7.7	-8.3	-12.48	-0.2			31	-28.69	0.85		3.16
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-12.44	-0.2		33	43	-28.65	0.85	5.2	15.2
	2100 MHz - AWS - LTE		-7.7	-5.1	-11.87	-0.2	9		29	-24.88	0.85		4.97
1-A-6	1900 MHz - PCS - GSM	-1.7	-10.7	-3.2	-8.37	-0.2			31	-24.18	5.85		12.67
	1900 MHz - PCS - WCDMA	-1.7	-10.7	-3.2	-8.33	-0.2		33	43	-24.14	5.85	14.71	24.71
	2100 MHz - AWS - LTE	-1.7	-10.7		-7.54	-0.2	9		29	-20.15	5.85		14.7
1-A-7	1900 MHz - PCS - GSM		-7.7	-8.3	-8.36	-0.2			31	-24.57	5.85		12.28
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-8.32	-0.2		33	43	-24.53	5.85	14.32	24.32
	2100 MHz - AWS - LTE		-7.7	-5.1	-7.53	-0.2	9		29	-20.54	5.85		14.31
1-A-8	1900 MHz - PCS - GSM	-4.1		-8.3	-14.55	-0.2			31	-27.14	5.85		9.71
	1900 MHz - PCS - WCDMA	-4.1		-8.3	-14.51	-0.2		33	43	-27.1	5.85	11.75	21.75
	2100 MHz - AWS - LTE	-4.1		-5.1	-14.02	-0.2	9		29	-23.42	5.85		11.43
1-A-9	1900 MHz - PCS - GSM		-7.7	-8.3	-13.73	-0.2			31	-29.93	5.85		6.92
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-13.69	-0.2		33	43	-29.9	5.85	8.95	18.95

	2100 MHz - AWS - LTE		-7.7	-5.1	-13.19	-0.2	9		29	-26.2	5.85		8.65
1-A-10	1900 MHz - PCS - GSM	-4.1		-8.3	-14.67	-0.2			31	-27.26	5.85		9.59
	1900 MHz - PCS - WCDMA	-4.1		-8.3	-14.63	-0.2		33	43	-27.22	5.85	11.63	21.63
	2100 MHz - AWS - LTE	-4.1		-5.1	-14.14	-0.2	9		29	-23.55	5.85		11.3
1-A-11	1900 MHz - PCS - GSM	-4.1		-8.3	-14.47	-0.2			31	-27.07	5.85		9.78
	1900 MHz - PCS - WCDMA	-4.1		-8.3	-14.43	-0.2		33	43	-27.03	5.85	11.82	21.82
	2100 MHz - AWS - LTE	-4.1		-5.1	-13.94	-0.2	9		29	-23.35	5.85		11.5
1-A-12	1900 MHz - PCS - GSM	-2.4	-7.7	-3.2	-12.33	-0.2			31	-25.83	5.85		11.02
	1900 MHz - PCS - WCDMA	-2.4	-7.7	-3.2	-12.29	-0.2		33	43	-25.79	5.85	13.06	23.06
	2100 MHz - AWS - LTE	-2.4	-7.7		-11.7	-0.2	9		29	-22.01	5.85		12.84
1-A-13	1900 MHz - PCS - GSM	-5.5		-6.5	-15.86	-0.2			31	-28.06	5.85		8.79
	1900 MHz - PCS - WCDMA	-5.5		-6.5	-15.82	-0.2		33	43	-28.03	5.85	10.82	20.82
	2100 MHz - AWS - LTE	-5.5		-3.3	-16.15	-0.2	9		29	-25.14	5.85		9.71
1-A-14	1900 MHz - PCS - GSM	-5.5		-6.5	-12.88	-0.2			31	-25.09	5.85		11.76
	1900 MHz - PCS - WCDMA	-5.5		-6.5	-12.84	-0.2		33	43	-25.05	5.85	13.8	23.8
	2100 MHz - AWS - LTE	-5.5		-3.3	-13.01	-0.2	9		29	-22	5.85		12.85
1-A-15	1900 MHz - PCS - GSM	-1.7	-7.7	-6.5	-8.27	-0.2			29	-24.37	5.85		10.48
	1900 MHz - PCS - WCDMA	-1.7	-7.7	-6.5	-8.27	-0.2		28	38	-24.37	5.85	9.48	19.48
	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-8.2	-0.2	9		29	-21.1	5.85		13.75

1-A-16	1900 MHz - PCS - GSM	-1.7	-7.7	-6.5	-5.91	-0.2			29	-22.01	5.85		12.84
	1900 MHz - PCS - WCDMA	-1.7	-7.7	-6.5	-5.91	-0.2		28	38	-22.01	5.85	11.84	21.84
	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-5.71	-0.2	9		29	-18.61	5.85		16.24
1-A-17	1900 MHz - PCS - GSM		-15.4	-3.2	-4.16	-0.2			29	-22.96	5.85		11.89
	1900 MHz - PCS - WCDMA		-15.4	-3.2	-4.16	-0.2		28	38	-22.96	5.85	10.89	20.89
	2100 MHz - AWS - LTE		-15.4		-3.87	-0.2	9		29	-19.47	5.85		15.38
1-A-18	1900 MHz - PCS - GSM	-3.4		-6.5	-11.54	-0.2			29	-21.63	5.85		13.22
	1900 MHz - PCS - WCDMA	-3.4		-6.5	-11.54	-0.2		28	38	-21.63	5.85	12.22	22.22
	2100 MHz - AWS - LTE	-3.4		-3.3	-11.66	-0.2	9		29	-18.57	5.85		16.28
1-A-19	1900 MHz - PCS - GSM	-1.7	-7.7	-6.5	-8.44	-0.2			29	-24.53	5.85		10.32
	1900 MHz - PCS - WCDMA	-1.7	-7.7	-6.5	-8.44	-0.2		28	38	-24.53	5.85	9.32	19.32
	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-8.38	-0.2	9		29	-21.29	5.85		13.56
1-A-20	1900 MHz - PCS - GSM	-2.4		-6.5	-12.54	-0.2			29	-21.63	5.85		13.22
	1900 MHz - PCS - WCDMA	-2.4		-6.5	-12.54	-0.2		28	38	-21.64	5.85	12.21	22.21
	2100 MHz - AWS - LTE	-2.4		-3.3	-12.97	-0.2	9		29	-18.87	5.85		15.98
1-A-21	1900 MHz - PCS - GSM	-0.7	-7.7	-6.5	-7.98	-0.2			29	-23.07	5.85		11.78
1-A-21	1900 MHz - PCS - WCDMA	-0.7	-7.7	-6.5	-7.98	-0.2		28	38	-23.08	5.85	10.77	20.77
	2100 MHz - AWS - LTE	-0.7	-7.7	-3.3	-8.17	-0.2	9		29	-20.07	5.85		14.78
1-A-22	1900 MHz - PCS - GSM		-10.7	-6.5	-5.88	-0.2			29	-23.27	5.85		11.58

	1900 MHz - PCS - WCDMA		-10.7	-6.5	-5.88	-0.2		28	38	-23.28	5.85	10.57	20.57
	2100 MHz - AWS - LTE		-10.7	-3.3	-5.99	-0.2	9		29	-20.18	5.85		14.67
1-A-23	1900 MHz - PCS - GSM		-7.7	-6.5	-7.52	-0.2			29	-21.92	5.85		12.93
	1900 MHz - PCS - WCDMA		-7.7	-6.5	-7.52	-0.2		28	38	-21.93	5.85	11.92	21.92
	2100 MHz - AWS - LTE		-7.7	-3.3	-7.75	-0.2	9		29	-18.94	5.85		15.91
1-A-24	1900 MHz - PCS - GSM	-1.7		-6.5	-12.41	-0.2			29	-20.8	5.85		14.05
	1900 MHz - PCS - WCDMA	-1.7		-6.5	-12.41	-0.2		28	38	-20.81	5.85	13.04	23.04
	2100 MHz - AWS - LTE	-1.7		-3.3	-12.85	-0.2	9		29	-18.04	5.85		16.81
1-A-25	1900 MHz - PCS - GSM	-1.7	-7.7	-6.5	-13.1	-0.2			29	-29.19	5.85		5.66
	1900 MHz - PCS - WCDMA	-1.7	-7.7	-6.5	-13.1	-0.2		28	38	-29.19	5.85	4.66	14.66
	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-13.25	-0.2	9		29	-26.15	5.85		8.7
1-A-26	1900 MHz - PCS - GSM		-7.7	-8.3	-10.94	-0.2			31	-27.15	5.85		9.7
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-10.9	-0.2		33	43	-27.11	5.85	11.74	21.74
	2100 MHz - AWS - LTE		-7.7	-5.1	-11.07	-0.2	9		29	-24.06	5.85		10.79
1-A-27	1900 MHz - PCS - GSM		-7.7	-8.3	-11.39	-0.2			31	-27.59	0.85		4.26
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-11.35	-0.2		33	43	-27.56	0.85	6.29	16.29
	2100 MHz - AWS - LTE		-7.7	-5.1	-11.54	-0.2	9		29	-24.53	0.85		5.32
1-A-28	1900 MHz - PCS - GSM		-7.7	-8.3	-12.42	-0.2			31	-28.62	0.85		3.23
	1900 MHz - PCS - WCDMA		-7.7	-8.3	-12.38	-0.2		33	43	-28.58	0.85	5.27	15.27

	2100 MHz - AWS - LTE		-7.7	-5.1	-12.62	-0.2	9		29	-25.61	0.85		4.24
1-A-30	2100 MHz - AWS - LTE		-7.7	-5.1	-11.21		9		29	-24.01	0.85		5.84
1-A-31	2100 MHz - AWS - LTE	-1.7	-10.7		-6.88		9		29	-19.28	5.85		15.57
1-A-32	2100 MHz - AWS - LTE		-7.7	-5.1	-6.87		9		29	-19.67	5.85		15.18
1-A-33	2100 MHz - AWS - LTE	-4.1		-5.1	-13.36		9		29	-22.55	5.85		12.3
1-A-34	2100 MHz - AWS - LTE		-7.7	-5.1	-12.53		9		29	-25.33	5.85		9.52
1-A-35	2100 MHz - AWS - LTE	-4.1		-5.1	-13.48		9		29	-22.68	5.85		12.17
1-A-36	2100 MHz - AWS - LTE	-4.1		-5.1	-13.36		9		29	-22.55	5.85		12.3
1-A-37	2100 MHz - AWS - LTE	-2.4	-7.7		-11.04		9		29	-21.14	5.85		13.71
1-A-48	2100 MHz - AWS - LTE	-3.8	-7.7		-10.42		9		29	-21.91	0.85		7.94
1-A-49	2100 MHz - AWS - LTE	-1.7	-10.7	-3.3	-8.04		9		29	-23.75	5.85		11.1
1-A-50	2100 MHz - AWS - LTE	-3.1	-10.7		-9.47		9		29	-23.27	5.85		11.58
1-A-51	2100 MHz - AWS - LTE	-1.7	-10.7	-3.3	-5.93		9		29	-21.63	5.85		13.22
1-A-52	2100 MHz - AWS - LTE	-2.4	-10.7		-7.8		9		29	-20.9	5.85		13.95
1-A-53	2100 MHz - AWS - LTE	-5.5		-3.3	-15.79		9		29	-24.58	5.85		10.27
1-A-54	2100 MHz - AWS - LTE	-5.5		-3.3	-12.65		9		29	-21.44	5.85		13.41
1-A-55	2100 MHz - AWS - LTE		-7.7	-5.1	-10.71		9		29	-23.5	5.85		11.35
1-A-56	2100 MHz - AWS - LTE		-7.7	-5.1	-11.18		9		29	-23.98	0.85		5.87
1-A-57	2100 MHz - AWS - LTE		-7.7	-5.1	-12.26		9		29	-25.06	0.85		4.79

1-A-58	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-8.89		9		29	-21.59	5.85		13.26
1-A-59	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-8.23		9		29	-20.92	5.85		13.93
1-A-60	2100 MHz - AWS - LTE		-15.4		-4.97		9		29	-20.37	5.85		14.48
1-A-61	2100 MHz - AWS - LTE	-3.4		-3.3	-13.08		9		29	-19.78	5.85		15.07
1-A-62	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-9.75		9		29	-22.45	5.85		12.4
1-A-73	2100 MHz - AWS - LTE	-1.7	-7.7	-3.3	-12.31		9		29	-25.01	5.85		9.84
1-A-75	2100 MHz - AWS - LTE	-2.4		-3.3	-15.16		9		29	-20.86	5.85		13.99
1-A-76	2100 MHz - AWS - LTE	-0.7	-7.7	-3.3	-9.48		9		29	-21.17	5.85		13.68
1-A-77	2100 MHz - AWS - LTE		-10.7	-3.3	-6.29		9		29	-20.29	5.85		14.56
1-A-78	2100 MHz - AWS - LTE		-7.7	-3.3	-7.56		9		29	-18.56	5.85		16.29
1-A-79	2100 MHz - AWS - LTE	-1.7		-3.3	-13.26		9		29	-18.25	5.85		16.6
2-A-29	1900 MHz - PCS - GSM	-3.4		-6.5	-16.18	-0.2			29	-26.27	5.85		8.58
	1900 MHz - PCS - WCDMA	-3.4		-6.5	-16.18	-0.2		28	38	-26.27	5.85	7.58	17.58
	2100 MHz - AWS - LTE	-3.4		-3.3	-16.5	-0.2	9		29	-23.4	5.85		11.45
2-A-74	2100 MHz - AWS - LTE	-3.4		-3.3	-16.86		9		29	-23.56	5.85		11.29

Anexo 4: Lista de Materiales

Se presenta la lista de materiales usados en el diseño con sus precios unitarios de suministro e instalación y precios totales usado para calcular la rentabilidad del proyecto.

TABLA 1-1: LISTA DE MATERIALES

FUENTE: ELABORACIÓN PROPIA

Equipo	Manufacturador	Modelo	Descripción	Cantidad	Precio unitario de suministro e instalación	Precio Total
Antena	RFS	I-ATP1-800/2700 P	Antena Panel *Indoor* - 698-960 MHz / 1710-2700 MHz- N-Hembra	52	$150.00	$7,800.00
Antena	RFS	I-ATO1-698/2700 P	Antena Omnidireccional *Indoor* - 698-2700 MHz	8	$85.00	$680.00
Atenuador	RFS	N-TER-100	Carga - 100 Watt - N tipo macho	4	$650.00	$2,600.00
Cable	RFS	LCF12-50 JFNL	Cable coaxial rígido de 1/2" de baja perdida	2244.13 m	$10.00	$22,441.30
Cable	RFS	LCF78-50J JFNL	Cable coaxial rígido de 7/8" de baja perdida	322.86 m	$18.00	$5,811.48

Equipo	Manufacturador	Modelo	Descripción	Cantidad	Precio unitario de suministro e instalación	Precio Total
Cable	RFS	SCF12-50JFN	Cable coaxial super flexible de 1/2" de baja perdida	218.21 m	$10.00	$2,182.10
Conector	RFS	NM-SCF12	Conector N macho para cable SCF12-50	84	$17.00	$1,428.00
Conector	RFS	716-SCF12	Conector 716 macho para cable SCF12-50	12	$17.00	$204.00
Conector	RFS	NM-LCF12	Conector N macho para cable LCF12-50	192	$17.00	$3,264.00
Conector	RFS	NM-LCF78-062	Conector N macho para cable UCF78-50A	16	$30.00	$480.00
Diplexer	RFS	FDAP5002/1C-3L	Diplexer de baja pérdida	4	$550.00	$2,200.00
Splitter	RFS	CDS10E-698/2700	*Tapper* de 10dB, 698-2700 MHz	10	$75.00	$750.00
Splitter	RFS	CDS6E-698/2700	*Tapper* de 6dB, 698-2700 MHz	18	$75.00	$1,350.00
Splitter	RFS	PDS2E-698/2700	Divisor de 2 vías, 698-2700 MHz	12	$60.00	$720.00

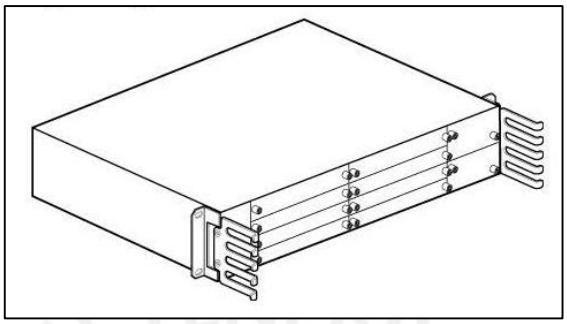
Equipo	Manufacturador	Modelo	Descripción	Cantidad	Precio unitario de suministro e instalación	Precio Total
Splitter	RFS	PDS3E-698/2700	Divisor de 3 vías, 698-2700 MHz	6	$70.00	$420.00
Combinador	RFS	CD3E-700/2700	*Coupler* de 3dB, bajo PIM. 700-2700 MHz	4	$650.00	$2,600.00
Radio Transceiver	Huawei	RRU-RRH	RRU 3942 GU/ RRH 3832 LTE	8	$2,500.00	$20,000.00
Base Band Unit	Huawei	BBU3900	BBU	1	$18,000.00	$18,000.00
FO	N/A	N/A	Fibra óptica	400 m	$12.00	$4,800.00
Rectificador *indoor*	N/A	APM 30	Convierte AC en DC estables para módulos 4G, 3G y 2G.	1	$8,000.00	$8,000.00
Rectificador *indoor*	N/A	N/A	Minirectificador	1	$3,000.00	$3,000.00
Tubo corrugado	N/A	Conduit	Para cable coaxial, adosado a la pared	3000 m	$14.00	$42,000.00
Cable conductor	INDECO	LSOH-70	Para energía AC y aterramiento	300 m	$22.00	$6,600.00
Tubería Conduit	N/A	Rígido	Diámetro 1´´ - para energía DC y aterramiento	1400 m	$12.00	$16,800.00

Equipo	Manufacturador	Modelo	Descripción	Cantidad	Precio unitario de suministro e instalación	Precio Total
Tuberia Conduit	N/A	Rígido	Diámetro 1 1/2´´ - para FO y conexión a mástil de microondas	180 m	$14.00	$2,520.00
Tablero eléctrico	PDP	-	220V AC	1	$2,200.00	$1,300.00
Otros	-	-	mástiles, cajas metálicas, barra de tierra, etc.			$5,000.00

Anexo 5: Equipos

Se presentan las especificaciones técnicas y físicas de los componentes usados en el desarrollo del diseño del proyecto.

- **BBU3900**



Mode	Capacity	
GSM	GTMU	• In versions earlier than GBSS14.0: A single site supports a maximum of 72 TRXs when the TDM transmission scheme is used or supports a maximum of 48 TRXs when the IP over E1 or IP over FE transmission scheme is used. In addition, a single site supports a maximum of 12 cells, and each cell supports a maximum of 24 carriers. • In GBSS14.0: • A single site supports a maximum of 126 TRXs when the TDM transmission scheme is used or supports a maximum of 48 TRXs when the IP over E1 transmission scheme is used or supports a maximum of 60 TRXs when the IP over FE transmission scheme is used. In addition, a single site supports a maximum of 32 cells, and each cell supports a maximum of 24 carriers. • In GBSS15.0: • A single site supports a maximum of 126 TRXs when the TDM transmission scheme is used or supports a maximum of 48 TRXs when the IP over E1 transmission scheme is used or supports a maximum of 72 TRXs when the IP over FE transmission scheme is used. In addition, a single site supports a maximum of 32 cells, and each cell supports a maximum of 24 carriers.

Mode	Capacity	
	UMPT	• In GBSS15.0: • A single site supports a maximum of 48 TRXs when the IP over E1 transmission scheme is used or supports a maximum of 72 TRXs when the IP over FE transmission scheme is used. In addition, a single site supports a maximum of 12 cells, and each cell supports a maximum of 24 carriers.
UMTS	• A single BBU: 24 cells, (uplink: 3072 channel elements (CEs); downlink: 4608 CEs) • Two interconnected BBUs: 48 cells (uplink: 5632 CEs; downlink: 8448 CEs) **NOTE** The preceding specifications are supported in RAN14.0.	
LTE	Maximum throughput per cell (20 MHz)	• Downlink throughput at the Media Access Control (MAC) layer: 150 Mbit/s (2 x 2 MIMO, 64 QAM) • Uplink throughput at the MAC layer: 70 Mbit/s (2 x 2 MU-MIMO or 2 x 4 MU-MIMO, 16 QAM)
	Maximum throughput per eNodeB (packet size: 550 bytes)	• LMPT: Uplink data rate at the MAC layer: 300 Mbit/s Downlink data rate at the MAC layer: 450 Mbit/s • UMPT: Uplink and downlink data rate at the MAC layer: 1500 Mbit/s
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (one LBBPc board)	• 1.4 MHz: 1008 UEs • 3 MHz/5 MHz/10 MHz: 1800 UEs • 15 MHz/20 MHz: 1800 UEs (cells with 2R configuration)/1200 UEs (cells with 4R configuration)
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (three LBBPc boards)	• 1.4 MHz: 3024 UEs • 3 MHz/5 MHz/10 MHz: 5400 UEs • 15 MHz/20 MHz: 5400 UEs (cells with 2R configuration)/3600 UEs (cells with 4R configuration)
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (one LBBPd1 or LBBPd2 board)	• 1.4 MHz: 504 UEs • 3 MHz: 1080 UEs • 5 MHz: 1800 UEs • 10 MHz/15 MHz/20 MHz: 3600 UEs

Mode	Capacity	
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (three LBBPd1 or LBBPd2 boards)	• 1.4 MHz: 1512 UEs • 3 MHz: 3240 UEs • 5 MHz: 5400 UEs • 10 MHz/15 MHz/20 MHz: 10,800 UEs
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (one LBBPd3 board)	• 1.4 MHz: 1008 UEs • 3 MHz: 2160 UEs • 5 MHz/10 MHz/15 MHz/20 MHz: 3600 UEs
	Maximum number of UEs in RRC_CONNECTED mode per eNodeB (three LBBPd3 boards)	• 1.4 MHz: 3024 UEs • 3 MHz: 6480 UEs • 5 MHz/10 MHz/15 MHz/20 MHz: 10,800 UEs
	Maximum throughput per LBBP	• LBBPc: – Downlink throughput: 300 Mbit/s – Uplink throughput: 100 Mbit/s • LBBPd1: – Downlink throughput: 450 Mbit/s – Downlink throughput: 225 Mbit/s • LBBPd2: – Downlink throughput: 600 Mbit/s – Uplink throughput: 225 Mbit/s • LBBPd3: – Downlink throughput: 600 Mbit/s – Downlink throughput: 300 Mbit/s
	Maximum number of concurrent Data Radio Bearers (DRBs) per UE	8

Mode	Specification
GU	GSM S24/24/24 + UMTS 3x8 Uplink: 2560 CEs Downlink: 3840 CEs

Mode	Specification
GL	GSM S24/24/24 + LTE 12 2T2R 20 MHz cells The sum of uplink and downlink data rates for an eNodeB at the MAC layer: 1500 Mbit/s
GUL	In SRAN8.0: S24/24/24 + UMTS 18 cells (3 cells x 2 carriers + 3 cells x 4 carriers) + LTE 12 cells (2 x (6 x 20 MHz), 2T2R, two LBBPd3)

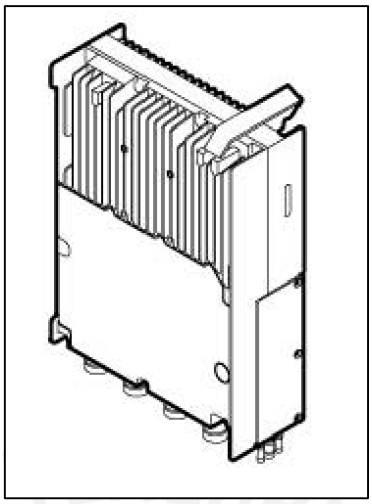
Item	Specification
Input power	UPEUc: -48 V DC Voltage range: -38.4 V DC to -57 V DC

Item	Specification
Dimensions (height x width x length)	86 mm x 442 mm x 310 mm
Weight	BBU3900 ≤ 12 kg (in full configuration) BBU3900 ≤ 7 kg (in typical configuration)

Item	Specification
Operating temperature	-20°C to +55°C (long-term) +55°C to +60°C (short-term)
Relative humidity	5% RH to 95% RH
Protection class	IP20
Atmospheric pressure	70 kPa to 106 kPa

FIGURA 1-1: BBU3900

- **RRU3832**



Mode	Frequency Band (MHz)	RX Frequency Band (MHz)	TX Frequency Band (MHz)
UMTS	2100	1920 to 1980	2110 to 2170
UO, LO, UL	AWS	1710 to 1755	2110 to 2155

Mode	Frequency Band (MHz)	1-Way Receiver Sensitivity (dBm)	2-Way Receiver Sensitivity (dBm)	4-Way Receiver Sensitivity (dBm)
UMTS	AWS/2100	–126.1	–128.9	–131.6
LTE	AWS/2100	-106.5	-109.3	N/A

Configu -ration	Output Power per Carrier (W)	Typical Power Consumption (W)	Maximum Power Consumption (W)	Power backup duration based on new batteries and typical power consumption (hour)	
				50Ah	92Ah
3 x 1	20	500	560	4.1	8.6
3 x 2	20	560	695	3.6	7.7
3 x 3	20	695	860	2.8	5.8
3 x 4	20	845	1085	2.1	4.4

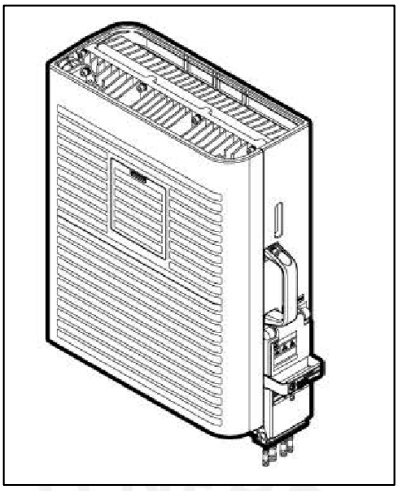
Item	Specification
Input power	–48 V DC; voltage range: –36 V DC to –57 V DC **NOTE** The RRU3832 supports AC applications after being configured with an AC/DC power module. For details, see the *AC/DC Power Module User Guide*.

Item	Specification
Dimensions (H x W x D)	400 mm x 300 mm x 100 mm (without the housing) 400 mm x 300 mm x 120 mm (with the housing)
Weight	14 kg (without the housing) 15 kg (with the housing)

Item	Specification
Operating temperature	–40℃ to +55℃ (without solar radiation) –40℃ to +50℃ (with solar radiation)
Relative humidity	5% RH to 100% RH
Absolute humidity	1 g/m^3 to 30 g/m^3
Atmospheric pressure	70 kPa to 106 kPa
Operating environment	Compliance standards: • 3GPP TS 25.141 • 3GPP TS 36.141 • ETSI EN 300019-1-4 V2.1.2 (2003-04) Class 4.1: "Non-weather protected locations"
Shockproof protection	NEBS GR63 zone4
Ingress Protection (IP) rating	IP65

FIGURA 1-2: RRU3832

- **RRU3942**



Frequency Band (MHz)	RX Frequency Band (MHz)	TX Frequency Band (MHz)
1900	1850–1910	1930–1990
850	824–849	869–894

Mode	Capacity
GSM	Each RRU3942 supports 8 TRXs.
UMTS	Each RRU3942 supports: • Non-MIMO: 6 carriers • MIMO: 4 carriers
LTE	1900 MHz: (SRAN 7.0) Each RRU3942 supports 2 carriers. The LTE bandwidth is 1.4, 3, 5, 10, 15, or 20 MHz.

Mode	Capacity
GSM+UMTS	• SRAN 6.0: For detailed specifications, see Table 2-6 and Table 2-7. • SRAN7.0: For detailed specifications, see Table 2-6, Table 2-7, Table 2-9, and Table 2-10.
GSM+LTE	1900 MHz: (SRAN 7.0) For detailed specifications, see Table 2-11.
UMTS+LTE	1900 MHz: (SRAN 7.0) For detailed specifications, see Table 2-12.

Mode	Frequency Band (MHz)	1-Way Receiver Sensitivity (dBm)	2-Way Receiver Sensitivity (dBm)	4-Way Receiver Sensitivity (dBm)
GSM	1900	–113.7	–116.5	–119.2 (theoretical value)
	850	–113.4	–116.2	–118.9 (theoretical value)
UMTS	1900	–125.8	–128.6	–131.3
	850	–125.5	–128.3	–131
LTE	1900	–106.3	–109.1	–111.8

Mode	Configuration	Output Power per Carrier (W)	Typical Power Consumption (W)	Maximum Power Consumption (W)
GSM	S2/2/2	20	690	800
	S4/4/4	20	935	1265
	S6/6/6	20	1100	1660
UMTS	3 x 1	20	635	715
	3 x 2	20	765	910
LTE	3 x 10 MHz	40	1040	1155
GSM+ UMTS	GSM S2/2/2+UMTS 3 x 1	GSM: 20 UMTS: 20	1020	1205
	GSM S3/3/3+UMTS 3 x 1	GSM: 20 UMTS: 20	1100	1405
	GSM S4/4/4+UMTS 3 x 1	GSM: 20 UMTS: 20	1200	1545
GSM+ LTE	GSM S2/2/2+LTE 3 x 10 MHz	GSM: 20 LTE: 40	1260	1480
	GSM S3/3/3+LTE 3 x 10 MHz	GSM: 20 LTE: 40	1305	1630
	GSM S4/4/4+LTE 3 x 10 MHz	GSM: 20 LTE: 40	1350	1775

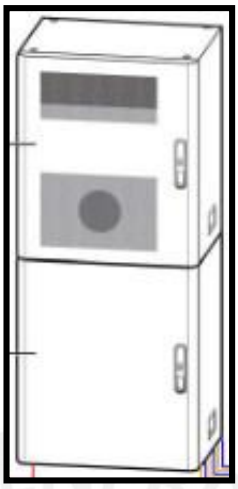
Item	Specifications
Input power	–48 V DC; voltage range: –36 V DC to –57 V DC **NOTE** The RRU3942 supports AC applications after being configured with an AC/DC power module. For details, see the AC/DC Power Module User Guide.

Item	Specifications
Dimensions (H x W x D)	485 mm x 380 mm x 170 mm (with the housing) 485 mm x 356 mm x 140 mm (without the housing)
Weight	25 kg (with the housing) 23.5 kg (without the housing)

Item	Specifications
Operating temperature	–40°C to +50°C (without solar radiation) –40°C to +45°C (with solar radiation)
Relative humidity	5% RH to 100% RH
Absolute humidity	1 g/m^3 to 30 g/m^3
Atmospheric pressure	70 kPa to 106 kPa
Operating environment	The RRU complies with the following standards: • 3GPP TS 45.005 • 3GPP TS 25.141 • 3GPP TS 36.141 • 3GPP TS 37.141 • ETSI EN 300019-1-4 V2.1.2 (2003-04) Class 4.1: "Non-weather protected locations."
Shockproof protection	NEBS GR63 zone4
Ingress Protection (IP) rating	IP65

FIGURA 1-3: RRU3942

- **APM30**



Function	Description
Providing space for the customer equipment	The APM30H provides a 7 U space for the customer equipment.
Providing backup power	The APM30H can connect to a single battery cabinet to support up to the 48 V 184 Ah battery pack or connect to two stacked battery packs to support up to 48 V 368 Ah battery pack.
Providing built-in PSUs	● The PSU converts the input AC mains power into -48 V DC power. ● The PSU is hot-swappable.
Providing a built-in PMU	● The PMU manages the PSUs and implements the battery charging and discharging functions. ● The PMU provides RS485 communication ports and dry contact alarm ports for remote and unattended monitoring. ● The PMU supports the battery low voltage disconnect (BLVD) and load low voltage disconnect (LLVD) functions. ● The PMU is hot-swappable.
Supporting AC input	The APM30H provides a built-in AC/DC power system, which supports single-phase 220 V AC, three-phase 220 V AC, and dual-live wire 110 V AC or 120 V AC.
Distributing AC power	Through the EPS, the AC power is distributed into two AC outputs: ● One output provides AC power for the SOU. ● The other output is connected to the AC power distribution box on the left of the cabinet. Through the power distribution, four AC outputs are provided to the heater or heating film.

Application Scenario	DC Output	Power Equipment	Silkscreen on the Output Terminal	Protection Component Type	Specification	Quantity	DC Output Terminal
Distributed base station	Six LLVD outputs	RRU	RRU0 to RRU5	MCB	20 A	6	Easy power receptacle (pressfit type) connector
	Nine BLVD outputs	TMC	TMC		25 A	1	
		FAN unit	LOAD0	Fuse	15 A	1	
		BBU	LOAD1 and LOAD2			2	
		TEC/FAN (in the battery cabinet)	LOAD3			1	
		TM	LOAD4 to LOAD7		5 A	4	

Item		Specification
AC input	Typical input voltage	200 V AC to 240 V AC (single-phase 220 V AC)
		200 V AC to 240 V AC or 346 V AC to 415 V AC (three-phase 220 V AC or 380 V AC)
		100 V AC to 120 V AC or 200 V AC to 240 V AC (dual-live-wire 110 V AC)
		120 V AC to 127 V AC or 208 V AC to 220 V AC (dual-live-wire 120 V AC)
	Operating voltage range	176 V AC to 290 V AC (single-phase 220 V AC)
		176 V AC to 290 V AC or 304 V AC to 500 V AC (three-phase 220 V AC)
		90 V AC to 135 V AC or 180 V AC to 270 V AC (dual-live-wire 110 V AC)
		105 V AC to 150 V AC or 176 V AC to 260 V AC (dual-live-wire 120 V AC)
	Frequency of the input voltage	50 Hz or 60 Hz
	Maximum input current	16 A (three-phase 220 V AC or 380 V AC)
		40 A (dual-live-wire 110 V AC, dual-live-wire 120 V AC, or single-phase 220 V AC)
	Input mode	• Three-phase 220 V AC or 380 V AC • Dual-live-wire 110 V AC • Dual-live-wire 120 V AC • Single-phase 220 V AC

Item		Specification
	AC input power	The AC input power varies according to AC load. ● When the PSU is configured: ⩽ 5,274 W ● When the PSU, heater, and heating film are configured: ⩽ 6,074 W ● When the PSU, heater, heating film, and SOU are configured: ⩽ 8,274 W
DC output	Output voltage range	-43.2 V DC to -57 V DC
	Output current range	● When two PSUs are configured: 0 A to 60 A ● When three PSUs are configured: 0 A to 90 A
	Typical output voltage	-53.5 V DC
	Number of DC outputs	The number of DC outputs varies according to application scenario. ● When working with a distributed base station: 16 DC outputs ● When working with a separated base station: 12 DC outputs
	DC output power	⩽ 3,200 W (two active PSUs and + one standby PSU)
Protection	Input protection	● Overvoltage protection: The system generates an alarm when the input voltage reaches the AC overvoltage alarm threshold, which is 280 V by default. ● Undervoltage protection: The system generates an alarm when the input voltage is lower than the AC undervoltage alarm threshold, which is 180 V by default.
	Output protection	● Overvoltage protection: The system generates an alarm when the busbar voltage reaches the DC overvoltage alarm threshold, which is -58 V by default. ● Undervoltage protection: The system generates an alarm when the busbar voltage is lower than the DC undervoltage alarm threshold, which is -45 V by default. ● Overcurrent protection and short-circuit protection
Permissible heat consumption in the cabinet		⩽ 700 W

Item	Specification	Remarks
Operating temperature	-40°C to +50°C (with solar radiation of 1,120 ± 10% W/m^2)	When the APM30H works under -20°C, a heater needs to be configured. NOTE The operating temperature for configuring a heater refers to the average of the local lowest temperatures for a month in a year.
Relative humidity	5% RH to 100% RH	-
Altitude	-60 m to +4,000 m	Above the altitude of 3,000 m, the maximum operating temperature decreases by 1°C each time the altitude increases by 100 m.
Wind speed	≤ 67 m/s	-
Storage temperature	-40°C to +70°C	-

FIGURA 1-4: APM30

- **Antena Panel I-ATP1**

Product Data Sheet **I-ATP1-698/2700P**

RFS

Indoor Panel Antenna 698-2700 MHz

Product Description

This panel antenna is specifically designed for broadband in-building distribution of modern wireless communication systems as LTE, GSM, CDMA, PCS, 3G, WiFi, WLAN services. The antenna ensures highest performance for in-building passive DAS applications avoiding passive intermodulation products due to the PIM optimized design. The antenna is constructed from lightweight materials ideal for easy ceiling mounting. The low profile and off-white radome blends easily into most building aesthetics with minimum visual impact.

Indoor Panel Antenna

Features/Benefits

- **LTE ready (700MHz and 2600MHz bands)**
- **Highest PIM performance**
- **RF Broadband, supports 698-2700 MHz**
- **Low VSWR**
- **Input power 50Watt maximum**
- **Supports all wireless communication standards**
- **Aesthetically designed, compact and light weight**
- **Off-white (ABS) radome**
- **Wall mount, easy to install**
- **Low loss pigtail with N female connector**

Technical Specifications

Product Type	Panel Antenna
Application	Indoor
Frequency Range, MHz	698-960 / 1710-2700
Number of Input Ports	1
Connectors	N female
Impedance, Ohm	50
VSWR (50 Ohm)	≤ 2.0 @698 - 960MHz ≤ 1.5 @1710 - 2700MHz
Intermodulation (IM3)	140 dBc with 2 x 33 dBm
Total Input Power, W	max. 50
Gain, dBi	6.0 ±1 @ 698 - 960 MHz 8.0 ±1 @ 1710 - 2700 MHz
Front-to-Back Ratio, dB	8 (698-960), 10 (1710-2700)
Polarization	Vertical
Horizontal Beamwidth, deg	90/70
Vertical Beamwidth, deg	65/60
Connector Cable, mm (in)	150 (5.90)
Radome Material	ABS
Radome Color	White (RAL9016)
Mounting Hardware included	Wall bracket, screws
Temperature Range, °C (°F)	-40 to +60 (-40 to 140)
Height (Less Connectors), mm (in)	50 (1.97)
Width (Less Connectors), mm (in)	170 (6.69)

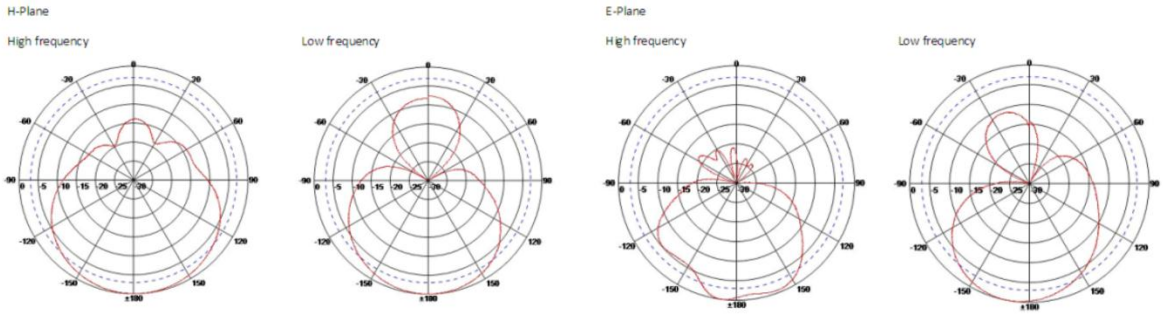
Product Data Sheet **I-ATP1-698/2700P**

Indoor Panel Antenna 698-2700 MHz

Length (Less Connectors), mm (in)	290 (11.42)
Weight, kg (lb)	0.7 (1.54)
Environmental Class	Indoor

Notes

Other Documentation



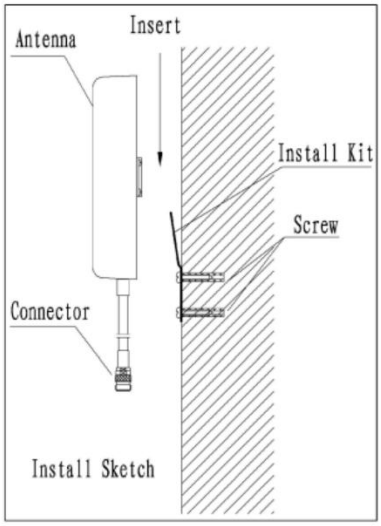


FIGURA 1-5: I-ATP1

- **Antena Omni I-ATO1**

Product Data Sheet **I-ATO1-698/2700P**

Indoor Omnidirectional Antenna 698-2700 MHz

Product Description

This omnidirectional antenna is specifically designed for broadband in-building distribution of modern wireless communication systems as LTE, GSM, CDMA, PCS, 3G, WiFi, WLAN services. The antenna ensures highest performance for in-building passive DAS applications avoiding passive intermodulation products due to the PIM optimized design. The antenna is constructed from lightweight materials ideal for easy ceiling mounting. The low profile and off-white radome blends easily into most building aesthetics with minimum visual impact.

Indoor Omnidirectional Antenna

Features/Benefits

- **LTE ready (700MHz and 2600MHz bands)**
- **Highest PIM performance**
- **RF Broadband, supports 698-2700 MHz**
- **Low VSWR**
- **Input power 50Watt maximum**
- **Supports all wireless communication standards**
- **Aesthetically designed, compact and light weight**
- **Off-white (ABS) radome**
- **Ceiling mount, easy to install**
- **Low loss pigtail with N female connector**

Technical Specifications

Product Type	Omnidirectional Antenna
Application	Indoor
Frequency Range, MHz	698-960 / 1710-2700
Number of Input Ports	1
Connectors	N female
Impedance, Ohm	50
VSWR (50 Ohm)	≤ 1.7 @ 698 - 690 MHz ≤ 1.5 @ 1710 - 2700 MHz
Intermodulation (IM3)	140 dBc with 2 x 33 dBm
Total Input Power, W	max. 50
Gain, dBi	2.0 ± 0.5 @ 698 - 960 MHz 3.0 ± 0.5 @ 1710 - 2700 MHz
Polarization	Vertical
Radome Material	ABS
Radome Color	White (RAL9003)
Mounting Hardware included	Ceiling mount, fixed with nut
Temperature Range, °C (°F)	-40 to +60 (-40 to 140)
Height (Less Connectors), mm (in)	113.5 (4.47)
Width (Less Connectors), mm (in)	Ø 203 (7.97)
Weight, kg (lb)	0.5 (1.10)
Environmental Class	Indoor

Notes

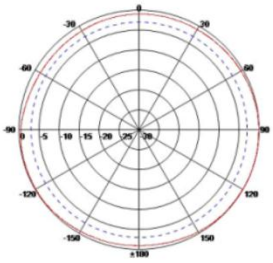
Other Documentation

Product Data Sheet **I-ATO1-698/2700P**

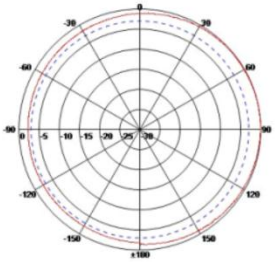
Indoor Omnidirectional Antenna 698-2700 MHz

H-Plane

High frequency

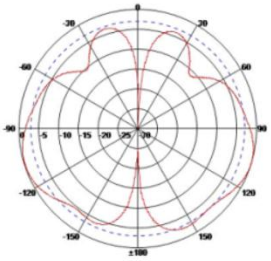


Low frequency

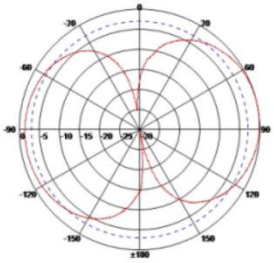


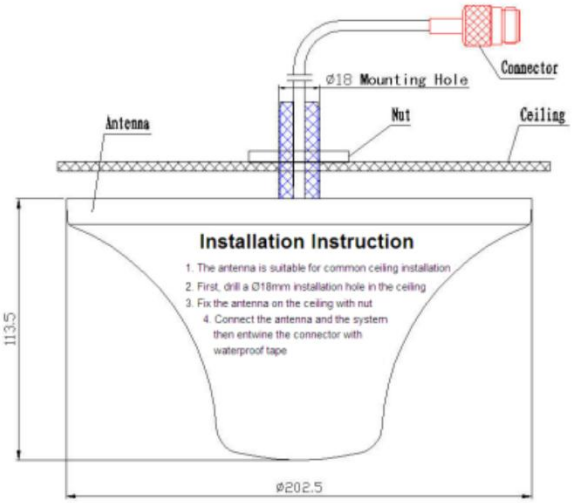
E-Plane

High frequency



Low frequency





RFS The Clear Choice ®	I-ATO1-698/2700P	Rev: A / 2013/02/06	Print Date: 15.05.2014

Please visit us on the internet at http://www.rfsworld.com/ Radio Frequency Systems

FIGURA 1-6: I-ATO1

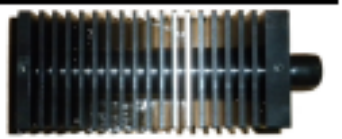
- **Carga 100W**

Product Data Sheet **N-TER-100**

Load, N male, 100 Watt

Product Description

The N-TER Series are coaxial loads, which operate from DC up to 3.0 GHz.



sample is N-TER-100

Features/Benefits

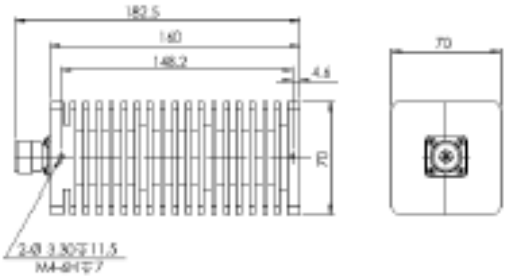
- Finned termination
- Low VSWR
- RoHS compliant
- Designed for wireless applications

Technical Specifications

Product Type	Load
Techn. Application	Indoor
Frequency Range, MHz	DC-3.000
Input Connector Type	N male
Impedance, Ohm	50
Max. VSWR / Return Loss, dB	1.2 / 20.8
Total Input Power, W	100
Temperature Range, °C (°F)	-40 to 65 (-40 to 149)
Height, mm (in)	182.5 (7.19)
Width, mm (in)	70 (2.76)
Length, mm (in)	70 (2.76)
Environmental Class	Indoor

Notes

Other Documentation



All information contained in the present datasheet is subject to confirmation at time of ordering

RFS The Clear Choice ® | N-TER-100 | Rev: B / 28.May.2014 | Print Date: 28.05.2014

Please visit us on the Internet at http://www.rfsworld.com/ Radio Frequency Systems

FIGURA 1-7: N-TER-100

- **Cable coaxial SCF12**

Product Data Sheet **SCF12-50J**

1/2" CELLFLEX® Superflexible Foam-Dielectric Coaxial Cable

Product Description

CELLFLEX® 1/2" superflexible cable

Application: OEM jumpers, Main feed transitions to equipment, GPS lines

1/2" CELLFLEX® Superflexible Foam Dielectric Coaxial Cable

Features/Benefits

- **Low Attenuation**
  The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transfer in your RF system.
- **Complete Shielding**
  The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  CELLFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, CELLFLEX® cable provides safe long term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

Technical Features

Structure

Inner conductor:	Copper-Clad Aluminum Wire	[mm (in)]	3.6 (0.14)
Dielectric:	Foam Polyethylene	[mm (in)]	8.3 (0.33)
Outer conductor:	Corrugated Copper	[mm (in)]	12.3 (0.48)
Jacket:	Polyethylene, PE	[mm (in)]	13.7 (0.54)

Mechanical Properties

Weight, approximately	[kg/m (lb/ft)]	0.21 (0.14)
Minimum bending radius, single bending	[mm (in)]	
Minimum bending radius, repeated bending	[mm (in)]	32 (1.3)
Bending moment	[Nm (lb-ft)]	1.8 (1.33)
Max. tensile force	[N (lb)]	650 (146)
Recommended / maximum clamp spacing	[m (ft)]	0.30 / 0.30 (1.00 / 1.00)

Electrical Properties

Characteristic impedance	[Ω]	50 +/- 1
Relative propagation velocity	[%]	82
Capacitance	[pF/m (pF/ft)]	82.0 (25.0)
Inductance	[µH/m (µH/ft)]	0.207 (0.063)
Max. operating frequency	[GHz]	11.7
Jacket spark test RMS	[V]	5000
Peak power rating	[kW]	20.4
RF Peak voltage rating	[V]	1430
DC-resistance inner conductor	[Ω/km (Ω/1000ft)]	2.9 (0.88)
DC-resistance outer conductor	[Ω/km (Ω/1000ft)]	4.1 (1.25)

Recommended Temperature Range

Storage temperature	[°C (°F)]	-70 to +85 (-94 to +185)
Installation temperature	[°C (°F)]	-40 to +60 (-40 to +140)
Operation temperature	[°C (°F)]	-50 to +85 (-58 to +185)

Other Characteristics

Fire Performance:	Halogene Free		
VSWR Performance:	Standard	[dB (VSWR)]	Contact RFS for your VSWR performance specification for your required frequency band.

Other Options: Phase stabilized and phase matched cables and assemblies are available upon request.

Frequency [MHz]	Attenuation [dB/100m]	Attenuation [dB/100ft]	Power [kW]
0.5	0.229	0.0697	20.4
1.0	0.324	0.0986	20.4
1.5	0.397	0.121	20.4
2.0	0.458	0.140	18.8
10	1.03	0.314	8.37
20	1.46	0.446	5.91
30	1.80	0.548	4.79
50	2.33	0.710	3.70
88	3.11	0.949	2.77
100	3.33	1.01	2.59
108	3.46	1.05	2.49
150	4.10	1.25	2.10
174	4.43	1.35	1.95
200	4.76	1.45	1.81
300	5.89	1.79	1.46
400	6.85	2.09	1.26
450	7.29	2.22	1.18
500	7.71	2.35	1.12
512	7.81	2.38	1.10
600	8.50	2.59	1.01
700	9.23	2.81	0.934
750	9.58	2.92	0.900
800	9.92	3.02	0.869
824	10.1	3.07	0.854
894	10.5	3.21	0.821
900	10.6	3.22	0.814
925	10.7	3.27	0.806
960	11.0	3.34	0.784
1000	11.2	3.41	0.770
1250	12.7	3.86	0.679
1400	13.5	4.11	0.639
1500	14.0	4.26	0.616
1700	15.0	4.57	0.575
1800	15.5	4.72	0.556
2000	16.4	5.01	0.526
2100	16.9	5.15	0.510
2200	17.3	5.28	0.498
2400	18.2	5.55	0.474
2500	18.6	5.68	0.464
2600	19.0	5.81	0.454
2700	19.5	5.93	0.442
3000	20.7	6.30	0.417
3500	22.6	6.88	0.382
4000	24.4	7.44	0.353
5000	27.8	8.48	0.310
6000	31.0	9.44	0.278
7000	34.0	10.4	0.254
8000	36.8	11.2	0.234
9000	39.6	12.1	0.218
10000	42.3	12.9	0.204
11700	46.6	14.2	0.185

Attenuation at 20°C (68°F) cable temperature
Mean power rating at 40°C (104°F) ambient temperature

FIGURA 1-8: SCF12-50JFNL

- **Cable coaxial LCF12**

Product Data Sheet **LCF12-50J**

1/2" CELLFLEX® Low-Loss Foam-Dielectric Coaxial Cable

RFS

Product Description

CELLFLEX® 1/2" low loss flexible cable

Application: OEM jumpers, Main feed transitions to equipment, GPS lines

1/2" CELLFLEX® Low-Loss Foam Dielectric Coaxial Cable

Features/Benefits

- **Low Attenuation**
  The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transfer in your RF system.
- **Complete Shielding**
  The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  CELLFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, CELLFLEX® cable provides safe long term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

Technical Features

Structure

Inner conductor:	Copper-Clad Aluminum Wire	[mm (in)]	4.8 (0.19)
Dielectric:	Foam Polyethylene	[mm (in)]	11.3 (0.44)
Outer conductor:	Annularly Corrugated Copper	[mm (in)]	13.8 (0.54)
Jacket:	Polyethylene, PE	[mm (in)]	15.8 (0.62)

Mechanical Properties

Weight, approximately	[kg/m (lb/ft)]	0.22 (0.15)
Minimum bending radius, single bending	[mm (in)]	70 (3)
Minimum bending radius, repeated bending	[mm (in)]	125 (5)
Bending moment	[Nm (lb-ft)]	6.5 (4.79)
Max. tensile force	[N (lb)]	1100 (247)
Recommended / maximum clamp spacing	[m (ft)]	0.6 / 1.0 (2.0 / 3.25)

Electrical Properties

Characteristic impedance	[Ω]	50 +/- 1
Relative propagation velocity	[%]	88
Capacitance	[pF/m (pF/ft)]	76.0 (23.2)
Inductance	[µH/m (µH/ft)]	0.190 (0.058)
Max. operating frequency	[GHz]	8.8
Jacket spark test RMS	[V]	8000
Peak power rating	[kW]	38
RF Peak voltage rating	[V]	1950
DC-resistance inner conductor	[Ω/km (Ω/1000ft)]	1.57 (0.48)
DC-resistance outer conductor	[Ω/km (Ω/1000ft)]	2.30 (0.70)

Recommended Temperature Range

Storage temperature	[°C (°F)]	-70 to +85 (-94 to +185)
Installation temperature	[°C (°F)]	-40 to +60 (-40 to +140)
Operation temperature	[°C (°F)]	-50 to +85 (-58 to +185)

Other Characteristics

Fire Performance:	Halogene Free		
VSWR Performance:	Standard	[dB (VSWR)]	Contact RFS for your VSWR performance specification for your required frequency band.

Other Options: Phase stabilized and phase matched cables and assemblies are available upon request.

Frequency	Attenuation		Power
[MHz]	[dB/100m]	[dB/100ft]	[kW]
0.5	0.149	0.0454	38.0
1.0	0.211	0.0643	38.0
1.5	0.258	0.0788	32.9
2.0	0.298	0.0910	28.5
10	0.671	0.204	12.7
20	0.951	0.290	8.93
30	1.17	0.356	7.26
50	1.51	0.462	5.63
88	2.02	0.616	4.21
100	2.16	0.658	3.93
108	2.24	0.684	3.79
150	2.66	0.810	3.19
174	2.87	0.875	2.96
200	3.08	0.940	2.76
300	3.81	1.16	2.23
400	4.43	1.35	1.92
450	4.71	1.44	1.80
500	4.98	1.52	1.71
512	5.04	1.54	1.69
600	5.48	1.67	1.55
700	5.95	1.81	1.43
750	6.17	1.88	1.38
800	6.39	1.95	1.33
824	6.49	1.98	1.31
894	6.78	2.07	1.25
900	6.80	2.07	1.25
925	6.90	2.10	1.23
960	7.04	2.15	1.21
1000	7.20	2.19	1.18
1250	8.12	2.48	1.05
1400	8.64	2.63	0.983
1500	8.97	2.73	0.947
1700	9.61	2.93	0.884
1800	9.91	3.02	0.857
2000	10.5	3.20	0.809
2100	10.8	3.29	0.787
2200	11.1	3.38	0.765
2400	11.6	3.54	0.732
2500	11.9	3.62	0.714
2600	12.2	3.70	0.696
2700	12.4	3.78	0.685
3000	13.2	4.01	0.644
3500	14.4	4.38	0.590
4000	15.5	4.72	0.548
5000	17.6	5.37	0.483
6000	19.6	5.97	0.433
7000	21.4	6.54	0.397
8000	23.2	7.07	0.366
8800	24.6	7.49	0.345

Attenuation at 20°C (68°F) cable temperature
Mean power rating at 40°C (104°F) ambient temperature

FIGURA 1-9: LCF12-50JFNL

- **Cable coaxial LCF78**

Product Data Sheet **LCF78-50JA**

7/8" CELLFLEX® Low-Loss Foam-Dielectric Coaxial Cable

RFS

Product Description

CELLFLEX® 7/8" SERIES "A" low loss flexible cable

Application: Main feed line

7/8" CELLFLEX® Low-Loss Foam Dielectric Coaxial Cable

Features/Benefits

- **Low Attenuation**
  The low attenuation of CELLFLEX® coaxial cable results in highly efficient signal transfer in your RF system.
- **Complete Shielding**
  The solid outer conductor of CELLFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of CELLFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  CELLFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, CELLFLEX® cable provides safe long term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

Frequency [MHz]	Attenuation [dB/100m]	Attenuation [dB/100ft]	Power [kW]
0.5	0.0780	0.0238	86.0
1.0	0.110	0.0337	85.0
1.5	0.135	0.0413	77.1
2.0	0.157	0.0477	66.6
10	0.353	0.107	29.6
20	0.501	0.153	20.9
30	0.616	0.188	17.0
50	0.801	0.244	13.1
88	1.07	0.327	9.75
100	1.15	0.349	9.12
108	1.19	0.363	8.76
150	1.42	0.431	7.38
174	1.53	0.466	6.83
200	1.65	0.502	6.35
300	2.04	0.622	5.12
400	2.38	0.726	4.39
450	2.54	0.773	4.12
500	2.69	0.819	3.89
512	2.72	0.829	3.84
600	2.97	0.904	3.52
700	3.23	0.983	3.24
800	3.47	1.06	3.01
824	3.53	1.08	2.96
894	3.69	1.13	2.83
900	3.71	1.13	2.82
925	3.76	1.15	2.78
960	3.84	1.17	2.72
1000	3.93	1.20	2.66
1250	4.45	1.36	2.35
1500	4.94	1.50	2.12
1700	5.30	1.62	1.97
1800	5.48	1.67	1.91
2000	5.82	1.77	1.80
2100	5.99	1.83	1.75
2200	6.15	1.88	1.70
2400	6.47	1.97	1.61
3000	7.38	2.25	1.42
3500	8.09	2.46	1.29
4000	8.78	2.67	1.19
4900	9.91	3.02	1.05
5000	10.0	3.05	1.04

Attenuation at 20°C (68°F) cable temperature
Mean power rating at 40°C (104°F) ambient temperature

Technical Features

Structure

Inner conductor:	Copper Tube	[mm (in)]	9.3 (0.37)
Dielectric:		[mm (in)]	21.5 (0.85)
Outer conductor:	Corrugated Copper	[mm (in)]	25.2 (0.99)
Jacket:	Polyethylene, PE	[mm (in)]	27.8 (1.09)

Mechanical Properties

Weight, approximately	[kg/m (lb/ft)]	0.48 (0.32)
Minimum bending radius, single bending	[mm (in)]	120 (5)
Minimum bending radius, repeated bending	[mm (in)]	250 (10)
Bending moment	[Nm (lb-ft)]	13.0 (9.6)
Max. tensile force	[N (lb)]	1440 (324)
Recommended / maximum clamp spacing	[m (ft)]	0.8 / 1.0 (2.75 / 3.25)

Electrical Properties

Characteristic impedance	[Ω]	50 +/- 1
Relative propagation velocity	[%]	89
Capacitance	[pF/m (pF/ft)]	75.0 (22.9)
Inductance	[µH/m (µH/ft)]	0.188 (0.057)
Max. operating frequency	[GHz]	5
Jacket spark test RMS	[V]	8000
Peak power rating	[kW]	85
RF Peak voltage rating	[V]	2910
DC-resistance inner conductor	[Ω/km (Ω/1000ft)]	1.54 (0.469)
DC-resistance outer conductor	[Ω/km (Ω/1000ft)]	1.09 (0.33)

Recommended Temperature Range

Storage temperature	[°C (°F)]	-70 to +85 (-94 to +185)
Installation temperature	[°C (°F)]	-40 to +60 (-40 to +140)
Operation temperature	[°C (°F)]	-50 to +85 (-58 to +185)

Other Characteristics

Fire Performance:	Halogene Free		
VSWR Performance:	Standard	[dB (VSWR)]	Contact RFS for your VSWR performance specification for your required frequency band.

Other Options: Phase stabilized and phase matched cables and assemblies are available upon request.

RFS The Clear Choice ®	LCF78-50JA	Rev: A0 / 29.Jan.2009	

FIGURA 1-10: LCF78-50JFNL

- **Diplexer FDAP5002**

Product Data Sheet **FDAP5002/1C-3L**

ShareLite AWS/PCS Low Loss Diplexer, full DC pass

Product Description

The FDAP Series of ShareLite diplexers are designed to enable feeder sharing between systems in the AWS and the PCS bands. The RFS innovative cavity filter design provides a very low insertion loss while keeping the product extremely compact and lightweight. The usage of highly selective filters also guarantees a high isolation level of 50dB between ports, ensuring an interference-free environment for any technology deployed. The filter design also has built-in lightning protection for additional reliability. Designed to withstand the most severe outdoor environments, it also features a IP67 class protection with a vented enclosure to avoid any possible effects of condensation and pressure instability, thus providing a long lasting, extremely reliable solution for any network.

Features/Benefits

- **Extremely low insertion loss**
- **High level of rejection between bands – Protects against interferences**
- **Compact design – Eases installation and reduces tower loading**
- **Exceptional reliability and environmental protection (IP67)**

Technical Specifications

Product Type	Diplexer/Cross Band Coupler
Application	AWS, PCS
Frequency Range 1, MHz	1850-1910 & 1930-1990
Frequency Range 2, MHz	1710-1755 & 2110-2155
Configuration	Sharelite Single/Double diplexer, outdoor/indoor, full DC pass
Mounting	Wall Mounting: With 4 screws (maximum 6mm diameter); Pole Mounting: With included clamp set 40-110mm (1.57-4.33)
Return Loss All Ports, Min, dB	20
Power Handling Continuous, Max, W	500
Impedance, Ohms	50
Insertion Loss, Path 1, dB	.20
Insertion Loss, Path 2, dB	.20
Rejection between Bands, Min, dB	50
IMP Level at the COM Port, Max, dBm	-112 @ 2x43
Temperature Range, °C (°F)	-40 to +60 (-40 to +140)
Environmental	ETSI 300-019-2-4 Class 4.1E
Ingress Protection	IP 67
Lightning Protection	IEC61000-4-5 Level 4 / 20kA, 8/20us
Connectors	In-line long-neck 7-16-Female
Weight, kg (lb)	2.9 (6.4)
Dimensions, H x W x D, mm (in)	165 x 210 x 85 (6.5 x 8.3 x 3.3)
Housing	Aluminum

Notes

Other Documentation

AWS/PCS Single or Dual Diplexer Installation Instructions: AWS-PCS_Diplexer_Installation_Rev5.pdf

Product Data Sheet	FDAP5002/1C-3L

ShareLite AWS/PCS Low Loss Diplexer, full DC pass

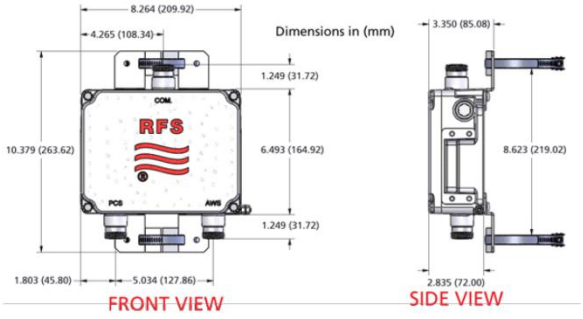


FIGURA 1-11: FDAP5002/1C-3L

- **Coupler CDS10E**

Product Data Sheet **CDS10E-698/2700**

10dB Directional Coupler

Product Description

RFS CDS**E series Directional Coupler has been designed for outdoor applications covering 698 to 2700MHz.

Units couple off a defined fraction of signal from 6 to 20 dB with minimal reflections or loss.The frequency range allows use with antennas and leaky cable systems and in wireless base stations.

With minimal solder joints, the dissipative loss has been minimized and reliability enhanced.

form as shown or similar

Features/Benefits

- **10 dB coupling value**
- **Low insertion Loss**
- **High power handling**
- **Small size, Low weight**
- **N-female connectors**
- **Low PIM**

Technical Specifications

Product Type	Directional Coupler
Application	Outdoor
Frequency Range, MHz	698-2700
Number of Input Ports	1
Number of Output Ports	2
Connectors	N
Input Connector Type	N-female
Output Connector Type	N-female
Impedance, Ohm	50
Insertion Loss, dB	≤ 0.7
VSWR (50 Ohm)	≤ 1.25
Intermodulation (IM3)	<-150 dBc with 2x43 dBm tones
Coupling Value, dB	10
Directivity, dB	≥ 20
Total Input Power, W	200
Temperature Range, °C (°F)	-25 to +55 (-13 to 131)
Height, mm (in)	18.0 (0.71)
Width, mm (in)	40.0 (1.57)
Length, mm (in)	123.0 (4.84)
Weight, kg (lb)	0.24 (0.53)
Environmental Class	IP65

Notes

Other Documentation

Product Data Sheet	CDS10E-698/2700

10dB Directional Coupler

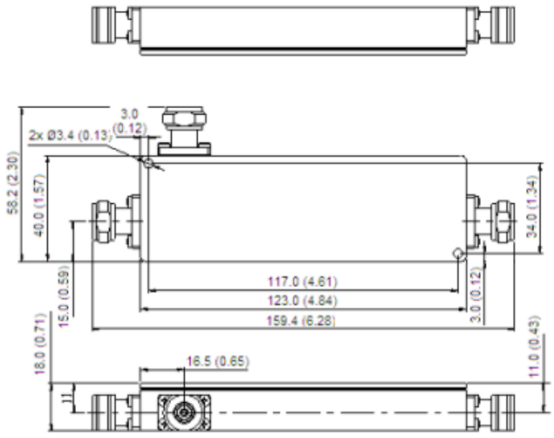


FIGURA 1-12: CDS10E

- **Coupler CDS6E**

Product Data Sheet **CDS6E-698/2700**

6dB Directional Coupler

Product Description

RFS CDS**E series Directional Coupler has been designed for outdoor applications covering 698 to 2700MHz.

Units couple off a defined fraction of signal from 6 to 20 dB with minimal reflections or loss.The frequency range allows use with antennas and leaky cable systems and in wireless base stations.

With minimal solder joints, the dissipative loss has been minimized and reliability enhanced.

form as shown or similar

Features/Benefits

- **6 dB coupling value**
- **Low insertion Loss**
- **High power handling**
- **Small size, Low weight**
- **N-female connectors**
- **Low PIM**

Technical Specifications

Product Type	Directional Coupler
Application	Outdoor
Frequency Range, MHz	698-2700
Number of Input Ports	1
Number of Output Ports	2
Connectors	N
Input Connector Type	N-female
Output Connector Type	N-female
Impedance, Ohm	50
Insertion Loss, dB	≤ 1.7
VSWR (50 Ohm)	≤ 1.25
Intermodulation (IM3)	<-150 dBc with 2x43 dBm tones
Coupling Value, dB	6
Directivity, dB	≥ 20
Total Input Power, W	200
Temperature Range, °C (°F)	-25 to +55 (-13 to 131)
Height, mm (in)	18.0 (0.71)
Width, mm (in)	40.0 (1.57)
Length, mm (in)	123.0 (4.84)
Weight, kg (lb)	0.24 (0.53)
Environmental Class	IP65

Notes

Other Documentation

Product Data Sheet	CDS6E-698/2700

6dB Directional Coupler

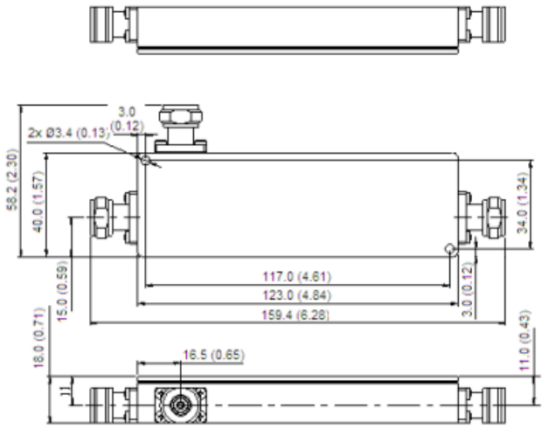


FIGURA 1-13: CDS6E

- **Splitter de 2**

Product Data Sheet **PDS2E-698/2700**

RFS

2 Way Power Divider

Product Description

This PDS*E series are Power Splitters, designed to evenly split high power cellular signals with minimal reflections or loss. They are specified to cover 698- 2700 MHz.
The wide frequency ranges of these models allow use with multiband antennas and leaky cable systems. With few solder joints and an air dielectric, the loss is minimal and reliability enhanced.

form as shown or similar

Features/Benefits

- **Multiple-Band Frequency Ranges**
- **200 Watt Power Rating**
- **High Reliability**
- **Low Cost Design for Outdoor Application**
- **Low Specified PIM**
- **N-female Connectors**

Technical Specifications

Product Type	Power Divider
Application	Outdoor
Frequency Range, MHz	698-2700
Number of Input Ports	1
Number of Output Ports	2
Connectors	N-female
Impedance, Ohm	50
Insertion Loss, dB	≤ 3.3
VSWR (50 Ohm)	≤ 1.25
Intermodulation (IM3)	-150 dBc with 2 x 43 dBm tones
Total Input Power, W	200
Temperature Range, °C (°F)	-25 to +65 (-13 to 149)
Height (Less Connectors), mm (in)	25.0 (0.98)
Width (Less Connectors), mm (in)	25.0 (0.98)
Length (Less Connectors), mm (in)	198.0 (7.80)
Weight, kg (lb)	0.30 (0.65)
Environmental Class	IP65

Notes

Other Documentation

Product Data Sheet **PDS2E-698/2700**

2 Way Power Divider

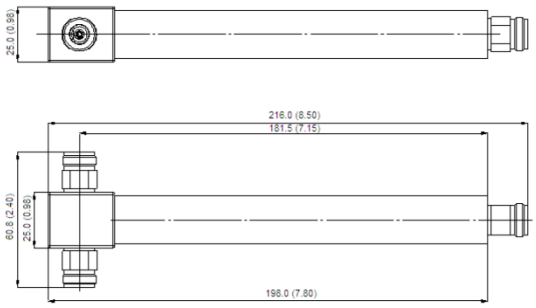


FIGURA 1-14: PDS2E

- **Splitter de 3**

Product Data Sheet PDS3E-698/2700

3 Way Power Divider

Product Description

This PDS*E series are Power Splitters, designed to evenly split high power cellular signals with minimal reflections or loss. They are specified to cover 698- 2700 MHz.
The wide frequency ranges of these models allow use with multiband antennas and leaky cable systems. With few solder joints and an air dielectric, the loss is minimal and reliability enhanced.

form as shown or similar

Features/Benefits

- **Multiple-Band Frequency Ranges**
- **200 Watt Power Rating**
- **High Reliability**
- **Low Cost Design for Outdoor Application**
- **Low Specified PIM**
- **N-female Connectors**

Technical Specifications

Product Type	Power Divider
Application	Outdoor
Frequency Range, MHz	698-2700
Number of Input Ports	1
Number of Output Ports	3
Connectors	N-female
Impedance, Ohm	50
Insertion Loss, dB	≤ 5.1
VSWR (50 Ohm)	≤ 1.25
Intermodulation (IM3)	-150 dBc with 2 x 43 dBm tones
Total Input Power, W	200
Temperature Range, °C (°F)	-25 to +65 (-13 to 149)
Height (Less Connectors), mm (in)	25.0 (0.98)
Width (Less Connectors), mm (in)	25.0 (0.98)
Length (Less Connectors), mm (in)	200.7 (7.90)
Weight, kg (lb)	0.28 (0.60)
Environmental Class	IP65

Notes

Other Documentation

Product Data Sheet **PDS3E-698/2700**

RFS

3 Way Power Divider

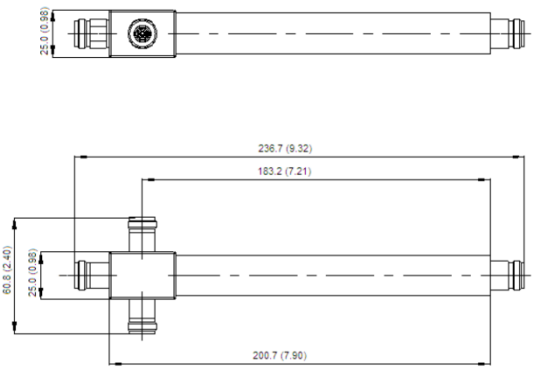


FIGURA 1-15: PDS3E

- **Combinador**

Product Data Sheet **CD3E-700/2700**

3dB Directional Hybrid Coupler

Product Description

The CD3E-700/2700 Hybrid Coupler have been designed to meet the special needs of the wireless market. They are most commonly used to combine two wireless carriers in the band to a single antenna feed or distribution cable. This requires the termination of one output port in 50 ohms and results in a 3 dB loss in each signal. In situations where two similar feeds are required, as required for an in-building application, both outputs may be used eliminating the need for a termination and the 3 dB loss.Isolation is maximized while passive intermodulation (PIM) is minimized.Connectors, spaced to allow controlled wrench tightening, are available with alternate genders.

form as shown or similar

Features/Benefits

- **Guaranteed PIM performance**
- **High Isolation, Low VSWR and Loss**
- **Single and Dual Band Ranges Tetra, SMR/PMR, 2G, 3G and WiFi**
- **160 Watt Average Power Rating**

Technical Specifications

Product Type	Directional Hybrid Coupler
Application	Outdoor
Frequency Range, MHz	700-2700
Number of Input Ports	2
Number of Output Ports	2
Connectors	N
Input Connector Type	N-female
Output Connector Type	N-female
Impedance, Ohm	50
Insertion Loss, dB	0.2, max.
VSWR (50 Ohm)	max. 1.2:1
Intermodulation (IM3)	<-150 dBc with 2x43 dBm tones
Isolation, dB	> 30
Coupling Value, dB	3
Input Power (Splitter mode), W	160, avg.
Max. RF Peak Power, kW	1.5
Temperature Range, °C (°F)	-35 to +65 (-31 to 149)
Height (Less Connectors), mm (in)	25.0 (0.98)
Width (Less Connectors), mm (in)	44.0 (1.73)
Length (Less Connectors), mm (in)	152 (5.98)
Mounts in 19" (483mm) EIA Rack	No
Weight, kg (lb)	0.644 (1.42)
Environmental Class	IP 64 (IP67 on request)

Notes

Other Documentation

FIGURA 1-16: CD3E

Anexo 6: Diagrama Eléctrico

El tablero eléctrico de la Azotea alimenta en AC al APM30. El APM30 convierte la corriente a DC, alimenta a la BBU y a las RRU/RRH de los sectores 2, 3 y 4.

El minirectificador convierte corriente AC del tablero eléctrico a corriente DC para alimentar a la RRU/RRH del sector 1. El minirectificador se usa por la lejanía del sector 1 al APM30. Se muestra el diagrama eléctrico del proyecto.

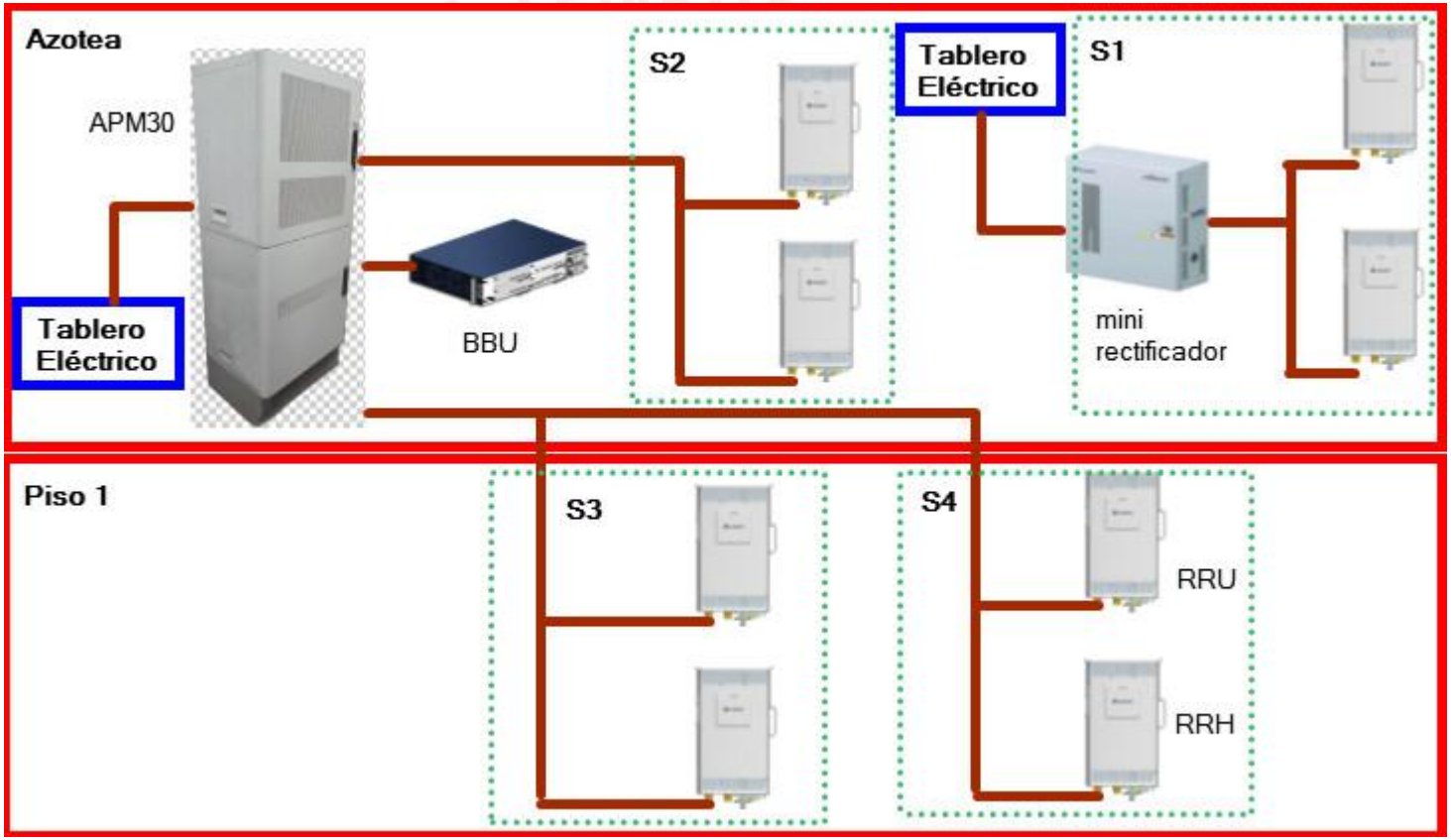


FIGURA 1-1: DIAGRAMA ELÉCTRICO

Anexo 7: Fotografías

Se presentan las fotografías que se obtuvieron en el TSS del cuarto de equipos, posible ubicación de antenas y vista 360 para la antena microondas.

Fotos panorámicas de Antena microondas

0°

30°

60°

90°

120°

150°

180°

210°

240°

270°

300°

330°

Fotografías de principales equipos

Se presentan fotomontajes de los principales equipos, esto nos da una idea de cómo sería la instalación del proyecto.

La ubicación de los equipos de los sectores 3 y 4 pertenecientes a las tiendas anclas Plaza Vea y Promart no se muestran debido a que no se tuvo permiso por parte de dichas tiendas para tomar las fotografías. Solo se muestra las áreas comunes.

BBU-APM30 y Antena microondas – Azotea

FIGURA 1-1: BBU-APM30 Y ANTENA MICROONDAS

RRU/RRH de Sector 1– Azotea

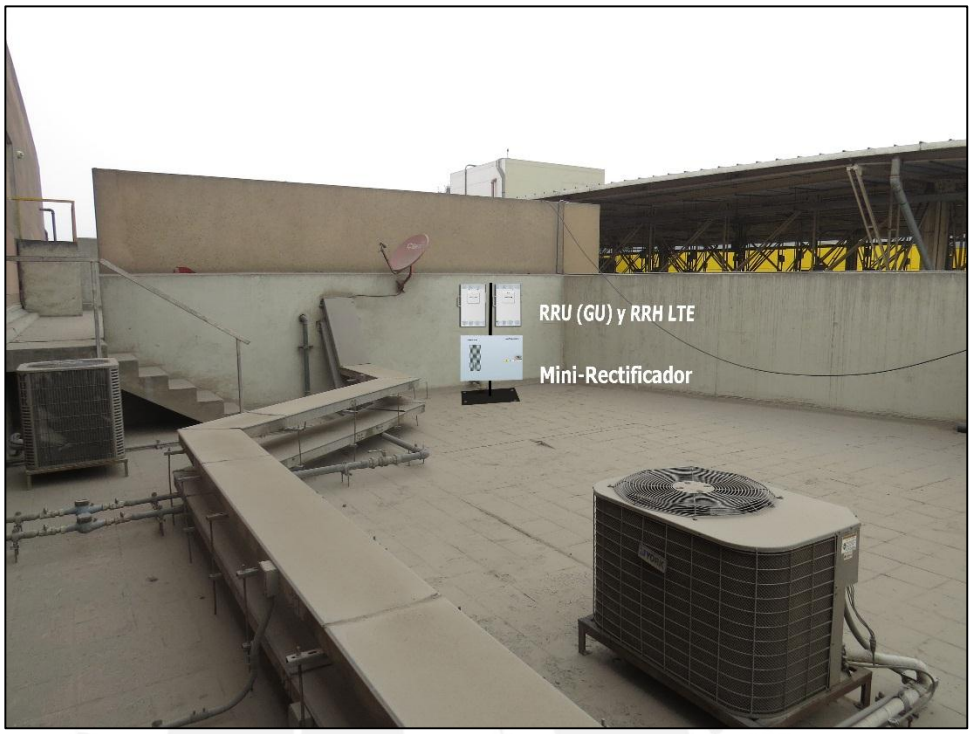


FIGURA 1-2: RRU y RRH DE SECTOR 1

RRU/RRH de Sector 2– Azotea

FIGURA 1-3: RRU y RRH DE SECTOR 2

Fotografías de emplazamiento de Antenas

Se muestra el fotomontaje de las antenas MIMO del proyecto.

La ubicación de las antenas de los sectores 3 y 4 pertenecientes a las tiendas anclas Plaza Vea y Promart no se muestran debido a que no se tuvo permiso por parte de dichas tiendas para tomar las fotografías. Solo se muestra las áreas comunes.

FIGURA 1-4: UBICACIÓN DE ANTENAS EN EL PLANO

- Antena 1-A-15 / 1-A-58

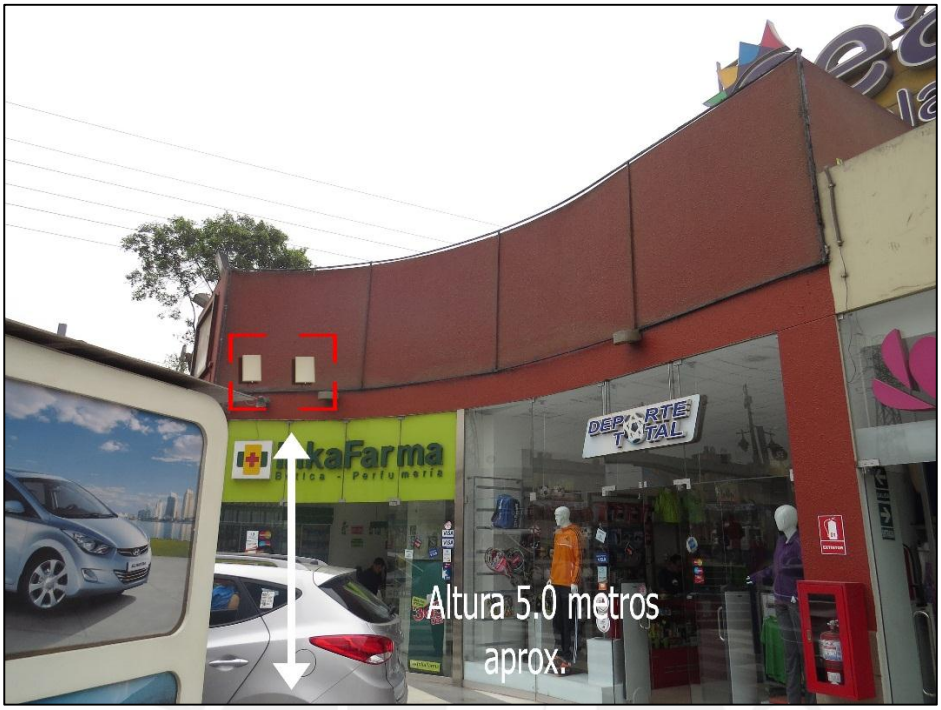


FIGURA 1-5: ANTENA PANEL MIMO 1-A-15 / 1-A-58

- Antena 1-A-16 / 1-A-59

FIGURA 1-6: ANTENA PANEL MIMO 1-A-16 / 1-A-59

- Antena 1-A-17 / 1-A-60

FIGURA 1-7: ANTENA PANEL MIMO 1-A-17 / 1-A-60

- Antena 1-A-18 / 1-A-61

FIGURA 1-8: ANTENA PANEL MIMO 1-A-18 / 1-A-61

- Antena 1-A-20 / 1-A-75

FIGURA 1-9: ANTENA PANEL MIMO 1-A-20 / 1-A-75

- Antena 1-A-21 / 1-A-76

FIGURA 1-10: ANTENA PANEL MIMO 1-A-21 / 1-A-76

- Antena 1-A-22 / 1-A-77

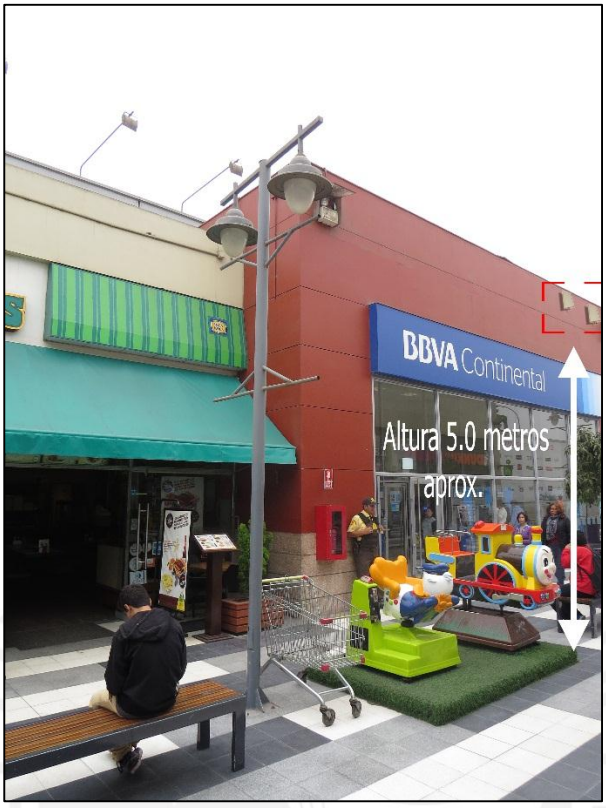


FIGURA 1-11: ANTENA PANEL MIMO 1-A-22 / 1-A-77

- Antena 1-A-23 / 1-A-78

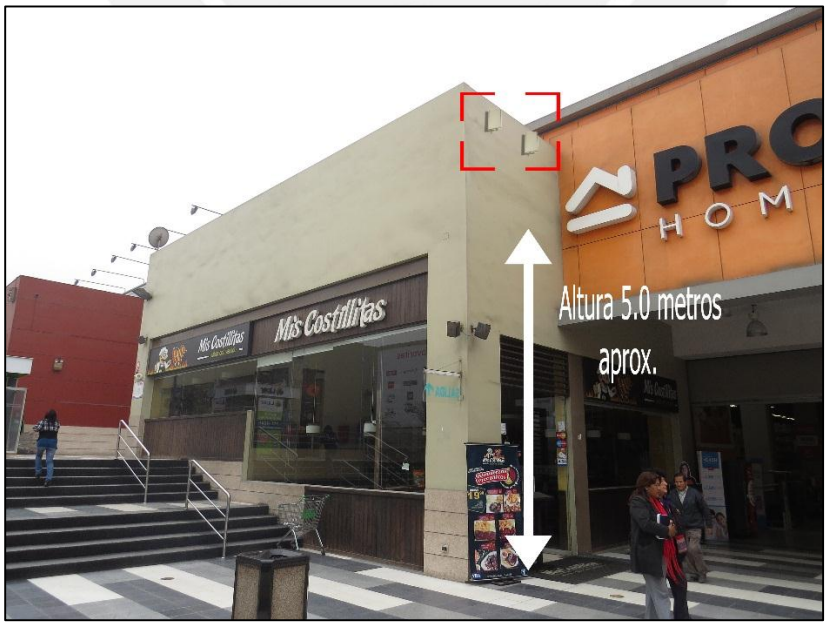


FIGURA 1-12: ANTENA PANEL MIMO 1-A-23 / 1-A-78

- Antena 1-A-24 / 1-A-79

FIGURA 1-13: ANTENA PANEL MIMO 1-A-24 / 1-A-79

- Antena 1-A-25 / 1-A-73

FIGURA 1-14: ANTENA PANEL MIMO 1-A-25 / 1-A-73

Anexo 8: Mediciones Finales

Se presentan las mediciones finales de los principales KPI para todo el centro comercial, un cuadro porcentual considerando como objetivo los rangos aceptables según los operadores, un cuadro estadístico general y un resumen total de los KPI.

- **KPI de 4G-LTE**

1. RSRP

- **Piso 1**

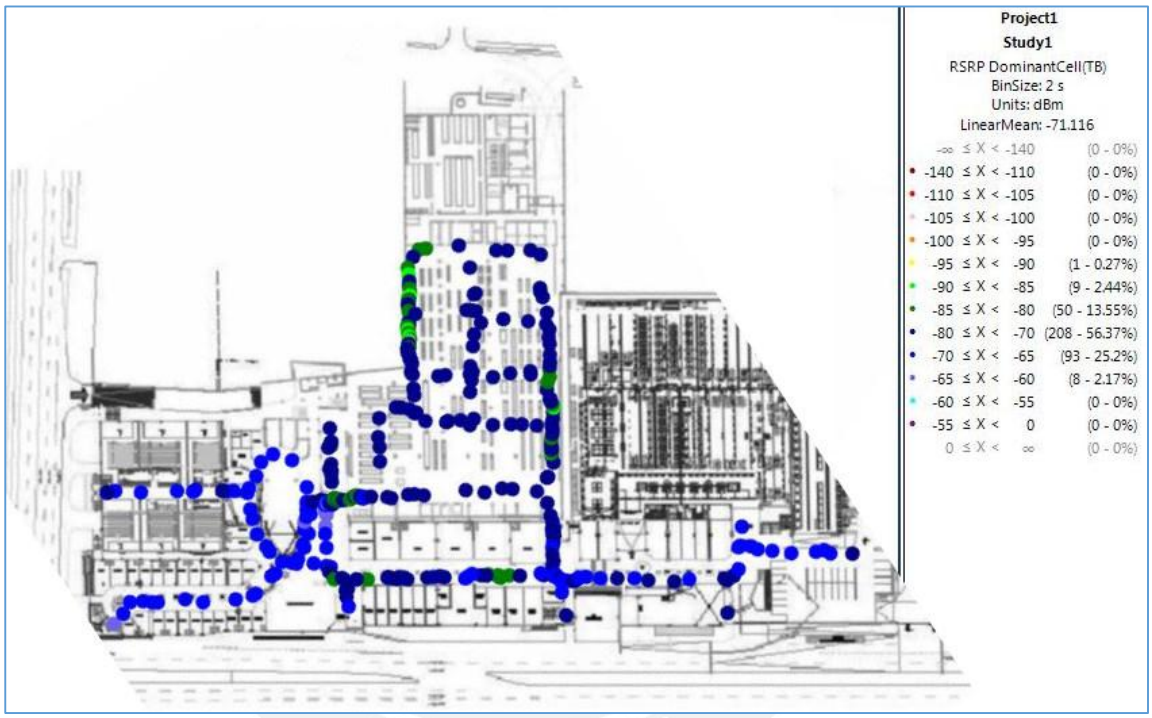


FIGURA 1-1: MEDICIÓN DE RSRP EN PISO 1

- **Piso 1 - *Mezzanine***

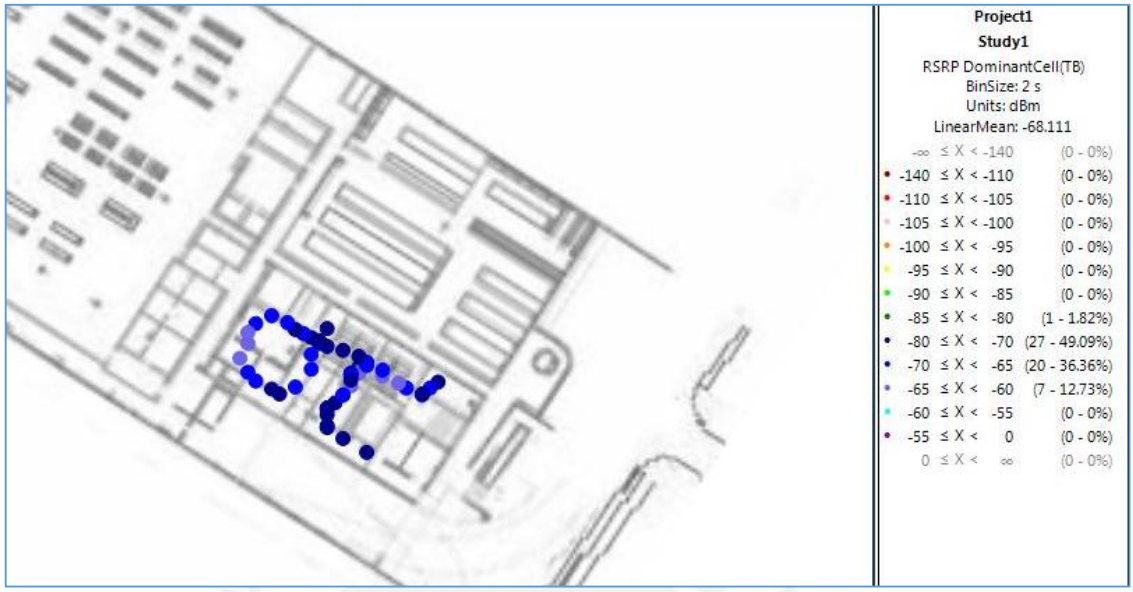


FIGURA 1-2: MEDICIÓN DE RSRP EN PISO 1 – *MEZZANINE*

- **Azotea**

FIGURA 1-3: MEDICIÓN DE RSRP EN AZOTEA

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRP (dBm)	# Muestras	Porcentaje	KPI
-55 to 0	0	0.00%	99.73%
-60 to -55	0	0.00%	
-65 to -60	8	2.17%	
-70 to -65	93	25.20%	
-80 to -70	208	56.37%	
-85 to -80	50	13.55%	
-90 to -85	9	2.44%	
-95 to -90	1	0.27%	0.27%
-100 to -95	0	0.00%	
-105 to -100	0	0.00%	
-110 to -105	0	0.00%	
-140 to -110	0	0.00%	

MEZANINE			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRP (dBm)	# Muestras	Porcentaje	KPI
-55 to 0	0	0.00%	100.00%
-60 to -55	0	0.00%	
-65 to -60	7	12.73%	
-70 to -65	20	36.36%	
-80 to -70	27	49.09%	
-85 to -80	1	1.82%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	0.00%
-100 to -95	0	0.00%	
-105 to -100	0	0.00%	
-110 to -105	0	0.00%	
-140 to -110	0	0.00%	

AZOTEA			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRP (dBm)	# Muestras	Porcentaje	KPI
-55 to 0	0	0.00%	100.00%
-60 to -55	0	0.00%	
-65 to -60	0	0.00%	
-70 to -65	0	0.00%	
-80 to -70	26	96.30%	
-85 to -80	1	3.70%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	0.00%
-100 to -95	0	0.00%	
-105 to -100	0	0.00%	
-110 to -105	0	0.00%	
-140 to -110	0	0.00%	

TOTAL			
RSRP (dBm)	# Muestras	Porcentaje	KPI
-55 to 0	0	0.00%	99.78%
-60 to -55	0	0.00%	
-65 to -60	15	3.33%	
-70 to -65	113	25.06%	
-80 to -70	261	57.87%	
-85 to -80	52	11.53%	
-90 to -85	9	2.00%	
-95 to -90	1	0.22%	0.22%
-100 to -95	0	0.00%	
-105 to -100	0	0.00%	
-110 to -105	0	0.00%	
-140 to -110	0	0.00%	

FIGURA 1-4: CUADRO PORCENTUAL GENERAL

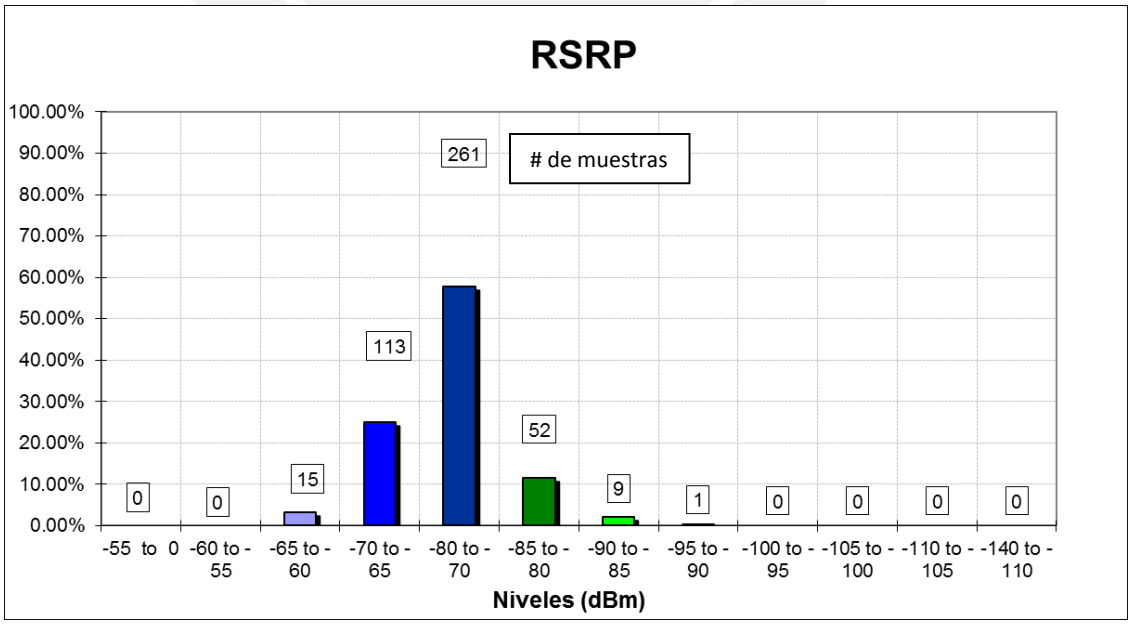


FIGURA 1-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 95% de las muestras de RSRP obtenidas dentro del rango RSRP>= -90dBm. Como se observa, se obtuvo el 99.78% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

2. RSRQ

- **Piso 1**

FIGURA 2-1: MEDICIÓN DE RSRQ EN PISO 1

- **Piso 1 - *Mezzanine***

FIGURA 2-2: MEDICIÓN DE RSRQ EN PISO 1 – *MEZZANINE*

- **Azotea**

FIGURA 2-3: MEDICIÓN DE RSRQ EN AZOTEA

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRQ (dB)	# Muestras	Porcentaje	KPI
-6 to 0	276	74.80%	100.00%
-8 to -6	93	25.20%	
-10 to -8	0	0.00%	
-12 to -10	0	0.00%	0.00%
-14 to -12	0	0.00%	
-16 to -14	0	0.00%	
-40 to -16	0	0.00%	

MEZANINE			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRQ (dB)	# Muestras	Porcentaje	KPI
-6 to 0	55	100.00%	100.00%
-8 to -6	0	0.00%	
-10 to -8	0	0.00%	
-12 to -10	0	0.00%	0.00%
-14 to -12	0	0.00%	
-16 to -14	0	0.00%	
-40 to -16	0	0.00%	

AZOTEA			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSRQ (dB)	# Muestras	Porcentaje	KPI
-6 to 0	3	11.11%	100.00%
-8 to -6	24	88.89%	
-10 to -8	0	0.00%	
-12 to -10	0	0.00%	0.00%
-14 to -12	0	0.00%	
-16 to -14	0	0.00%	
-40 to -16	0	0.00%	

TOTAL			
RSRQ (dB)	# Muestras	Porcentaje	KPI
-6 to 0	334	74.06%	100.00%
-8 to -6	117	25.94%	
-10 to -8	0	0.00%	
-12 to -10	0	0.00%	0.00%
-14 to -12	0	0.00%	
-16 to -14	0	0.00%	
-40 to -16	0	0.00%	

FIGURA 2-4: CUADRO PORCENTUAL GENERAL

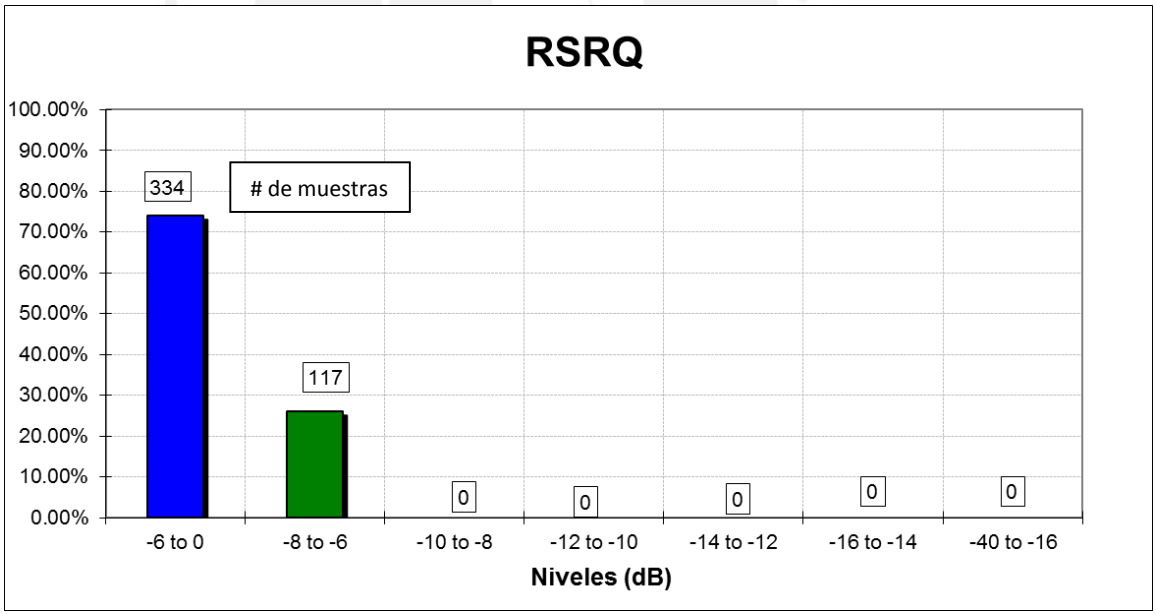


FIGURA 2-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 95% de las muestras de RSRQ obtenidas dentro del rango RSRQ>= -10dB. Como se observa, se obtuvo el 100% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

3. TASA DE DATOS

- **Piso 1**

FIGURA 3-1: MEDICIÓN DE TASA DE DATOS EN PISO 1

- **Piso 1 - *Mezzanine***

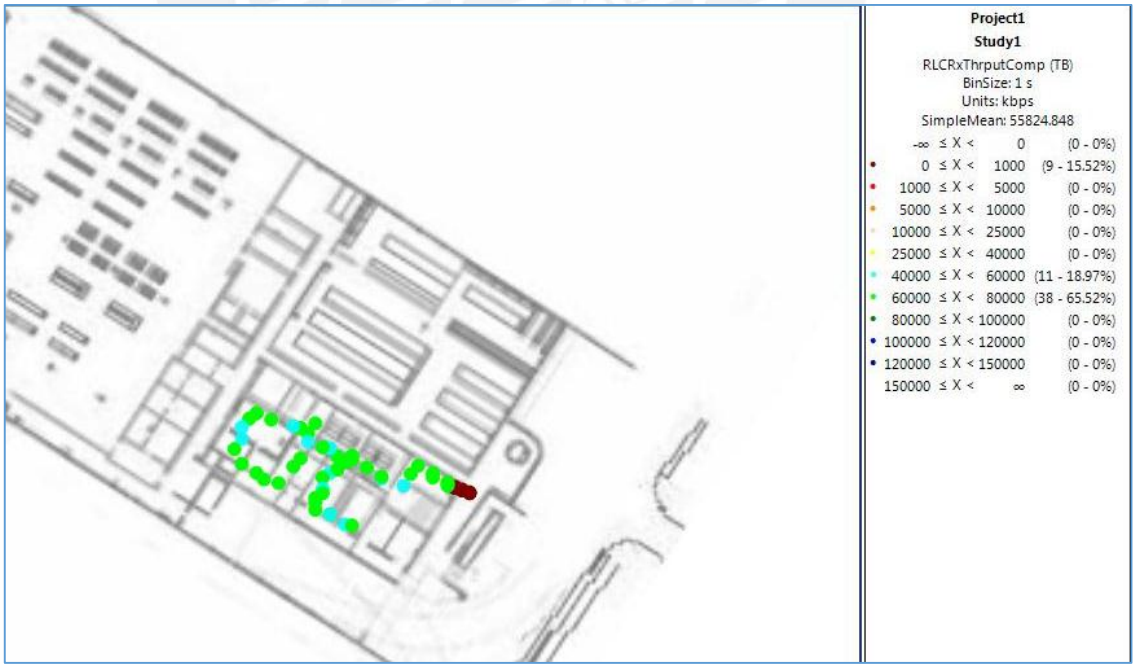


FIGURA 3-2: MEDICIÓN DE TASA DE DATOS EN PISO 1 – *MEZZANINE*

- **Azotea**

FIGURA 3-3: MEDICIÓN DE TASA DE DATOS EN AZOTEA

PISO 1

% de muestras dentro del rango aceptable que piden las operadoras			90%
MIMO DL Throughput (kbps)	# Muestras	Porcentaje	KPI
120000 to 150000	0	0.00%	97.27%
100000 to 120000	23	6.28%	
80000 to 100000	63	17.21%	
60000 to 80000	140	38.25%	
40000 to 60000	102	27.87%	
25000 to 40000	28	7.65%	
10000 to 25000	8	2.19%	2.73%
5000 to 10000	1	0.27%	
1000 to 5000	1	0.27%	
0 to 1000	0	0.00%	

MEZANINE

% de muestras dentro del rango aceptable que piden las operadoras			90%
MIMO DL Throughput (kbps)	# Muestras	Porcentaje	KPI
120000 to 150000	0	0.00%	100.00%
100000 to 120000	0	0.00%	
80000 to 100000	0	0.00%	
60000 to 80000	38	77.55%	
40000 to 60000	11	22.45%	
25000 to 40000	0	0.00%	
10000 to 25000	0	0.00%	0.00%
5000 to 10000	0	0.00%	
1000 to 5000	0	0.00%	
0 to 1000	0	0.00%	

AZOTEA

% de muestras dentro del rango aceptable que piden las operadoras			90%
MIMO DL Throughput (kbps)	# Muestras	Porcentaje	KPI
120000 to 150000	0	0.00%	100.00%
100000 to 120000	2	11.11%	
80000 to 100000	15	83.33%	
60000 to 80000	1	5.56%	
40000 to 60000	0	0.00%	
25000 to 40000	0	0.00%	
10000 to 25000	0	0.00%	0.00%
5000 to 10000	0	0.00%	
1000 to 5000	0	0.00%	
0 to 1000	0	0.00%	

TOTAL

MIMO DL Throughput (kbps)	# Muestras	Porcentaje	KPI
120000 to 150000	0	0.00%	97.69%
100000 to 120000	25	5.77%	
80000 to 100000	78	18.01%	
60000 to 80000	179	41.34%	
40000 to 60000	113	26.10%	
25000 to 40000	28	6.47%	
10000 to 25000	8	1.85%	2.31%
5000 to 10000	1	0.23%	
1000 to 5000	1	0.23%	
0 to 1000	0	0.00%	

FIGURA 3-4: CUADRO PORCENTUAL GENERAL

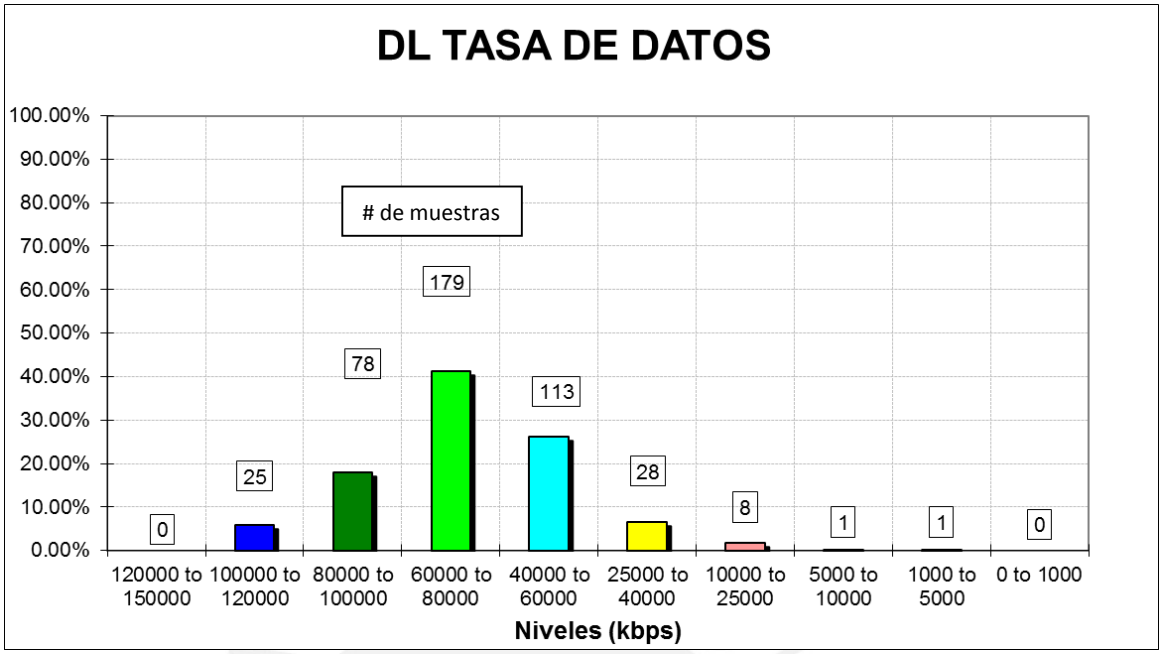


FIGURA 3-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 90% de las muestras de Tasa de Datos obtenidas dentro del rango DR>= 25Mbps. Como se observa, se obtuvo el 97.69% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

4. SNIR

- **Piso 1**

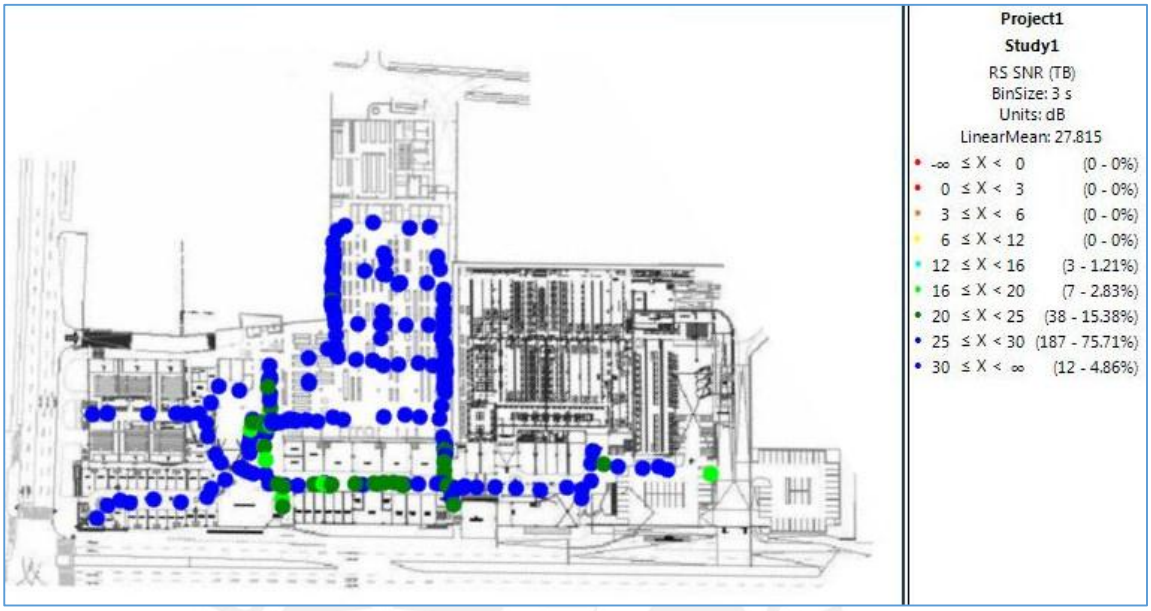


FIGURA 4-1: MEDICIÓN DE SNIR EN PISO 1

- **Piso 1 - *Mezzanine***

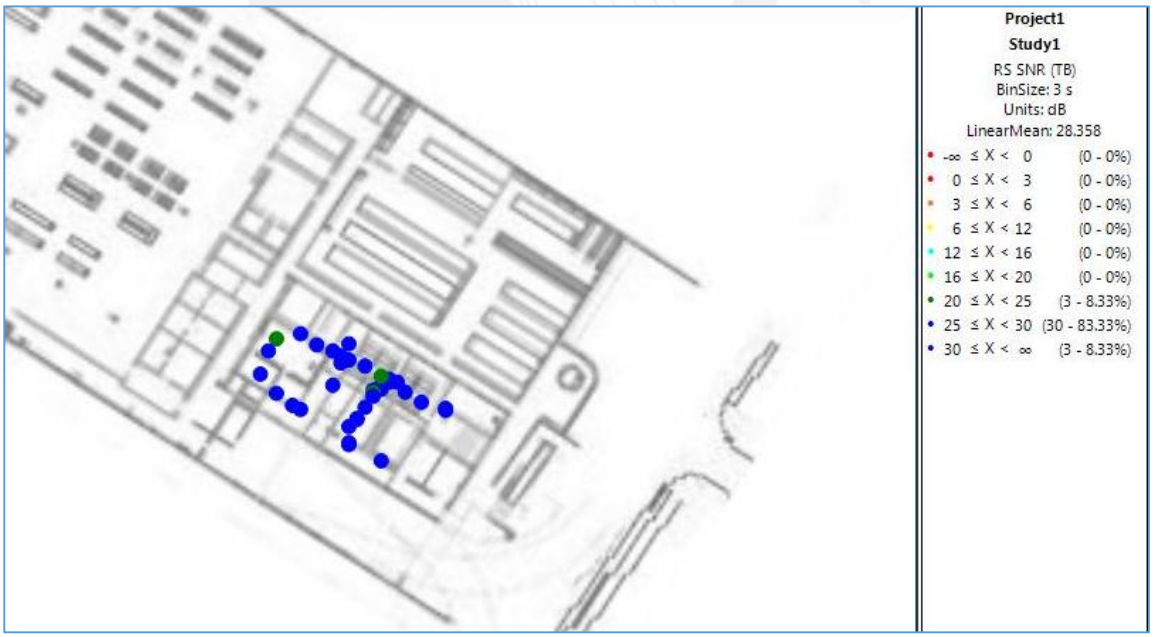


FIGURA 4-2: MEDICIÓN DE SNIR EN PISO 1 – *MEZZANINE*

- **Azotea**

FIGURA 4-3: MEDICIÓN DE SNIR EN AZOTEA

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			95%
SNR (dB)	# Muestras	Porcentaje	KPI
25 to 30	199	80.57%	95.95%
20 to 25	38	15.38%	
16 to 20	7	2.83%	4.05%
12 to 16	3	1.21%	
6 to 12	0	0.00%	
3 to 6	0	0.00%	
0 to 3	0	0.00%	

MEZANINE			
% de muestras dentro del rango aceptable que piden las operadoras			95%
SNR (dB)	# Muestras	Porcentaje	KPI
25 to 30	33	91.67%	100.00%
20 to 25	3	8.33%	
16 to 20	0	0.00%	0.00%
12 to 16	0	0.00%	
6 to 12	0	0.00%	
3 to 6	0	0.00%	
0 to 3	0	0.00%	

AZOTEA			
% de muestras dentro del rango aceptable que piden las operadoras			95%
SNR (dB)	# Muestras	Porcentaje	KPI
25 to 30	6	31.58%	100.00%
20 to 25	13	68.42%	
16 to 20	0	0.00%	0.00%
12 to 16	0	0.00%	
6 to 12	0	0.00%	
3 to 6	0	0.00%	
0 to 3	0	0.00%	

TOTAL			
SNR (dB)	# Muestras	Porcentaje	KPI
25 to 30	238	78.81%	96.69%
20 to 25	54	17.88%	
16 to 20	7	2.32%	3.31%
12 to 16	3	0.99%	
6 to 12	0	0.00%	
3 to 6	0	0.00%	
0 to 3	0	0.00%	

FIGURA 4-4: CUADRO PORCENTUAL GENERAL

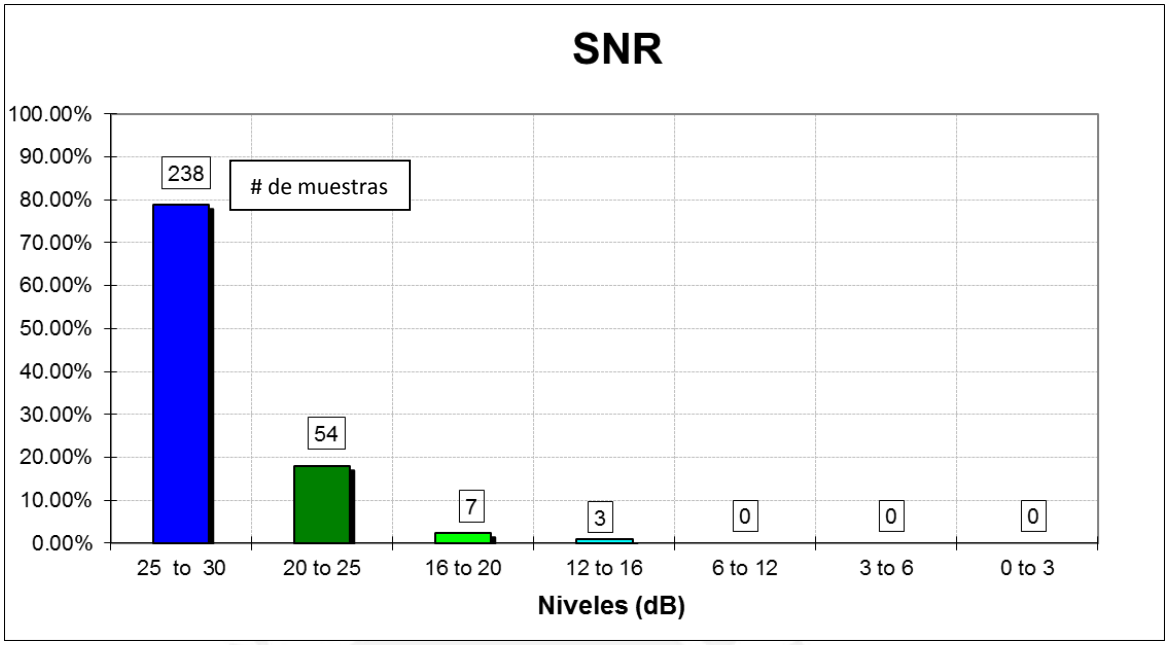


FIGURA 4-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 95% de las muestras de SNIR obtenidas dentro del rango SNIR>= 20dB. Como se observa, se obtuvo el 96.69% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

5. MEJOR SERVIDOR

- **Piso 1**

FIGURA 5-1: MEDICIÓN DE MEJOR SERVIDOR EN PISO 1

- **Piso 1 - *Mezzanine***

FIGURA 5-2: MEDICIÓN DE MEJOR SERVIDOR EN PISO 1 – *MEZZANINE*

- **Azotea**

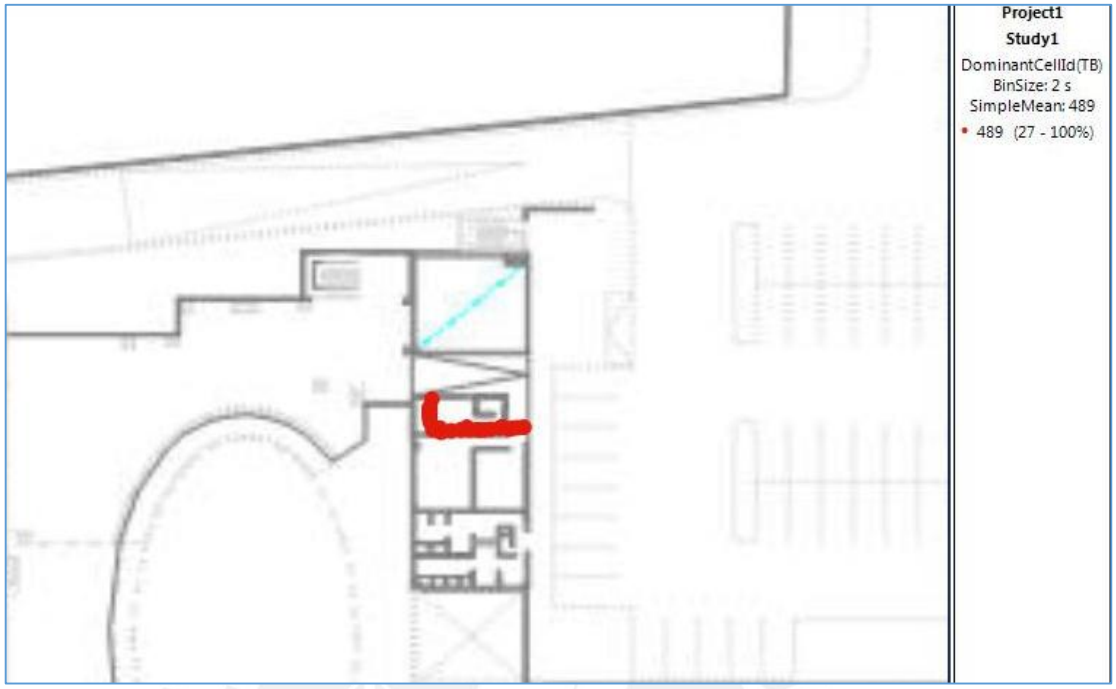


FIGURA 5-3: MEDICIÓN DE MEJOR SERVIDOR EN AZOTEA

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			99%
ID	# Muestras	Porcentaje	KPI
471	82	22.22%	100.00%
489	79	21.41%	
500	208	56.37%	
Otros		0.00%	0.00%

MEZANINE			
% de muestras dentro del rango aceptable que piden las operadoras			99%
ID	# Muestras	Porcentaje	KPI
		0.00%	100.00%
		0.00%	
500	55	100.00%	
Otros		0.00%	0.00%

AZOTEA			
% de muestras dentro del rango aceptable que piden las operadoras			99%
ID	# Muestras	Porcentaje	KPI
		0.00%	100.00%
489	27	100.00%	
		0.00%	
Otros		0.00%	0.00%

TOTAL			
ID	# Muestras	Porcentaje	KPI
471	82	18.18%	100.00%
489	106	23.50%	
500	263	58.31%	
Otros	0	0.00%	0.00%

FIGURA 5-4: CUADRO PORCENTUAL GENERAL

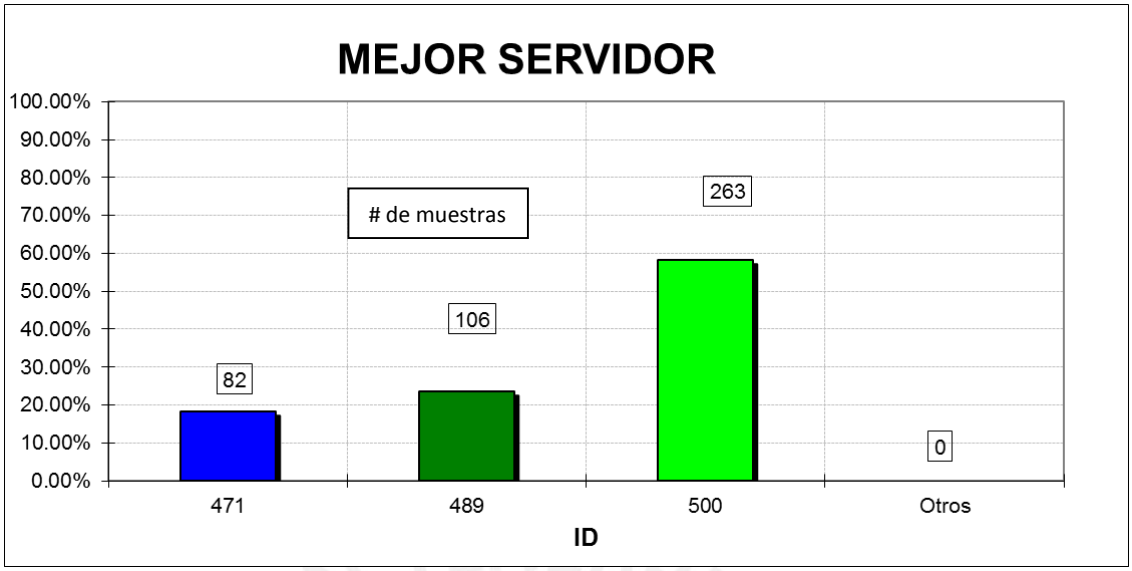


FIGURA 5-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 99% de las muestras de mejor servidor asignadas en el área *indoor*. Se recuerda que el operador asignó un *Cell* ID de 489 al sector 1, 471 al sector 2 y 500 al sector 3. Como se observa, se obtuvo que el 100% de las muestras obtenidas corresponden a los sectores *indoor* proyectados y no hay presencia de algún sector externo.

6. CSFB

Se hicieron pruebas de llamadas estando en 4G-LTE para medir los intentos fallidos y exitosos de llamada usando CSFB.

- **Piso 1**

Para el piso 1 se hicieron 15 llamadas en 4G-LTE. El siguiente gráfico muestra los 15 intentos de llamada y los 15 resultados que se obtuvieron.

Se aprecia que de los 15 intentos realizados los 15 fueron exitosos, teniendo una tasa de éxito del 100%.

All of 30	Timestamp	Longit	Latitu	All Even....EventId	All Event.Val...ddditionalInfo
1	09/04/2015 07:13:10.574 p.m.	-76.885007	-12.015201	Wams::CsfbStarts	
2	09/04/2015 07:13:53.714 p.m.	-76.885383	-12.015441	Wams::CsfbCompletes	Last csfb test status = Successful
3	09/04/2015 07:14:02.957 p.m.	-76.885441	-12.015519	Wams::CsfbStarts	
4	09/04/2015 07:14:45.131 p.m.	-76.885041	-12.015815	Wams::CsfbCompletes	Last csfb test status = Successful
5	09/04/2015 07:14:55.007 p.m.	-76.884920	-12.015809	Wams::CsfbStarts	
6	09/04/2015 07:15:38.828 p.m.	-76.884794	-12.015619	Wams::CsfbCompletes	Last csfb test status = Successful
7	09/04/2015 07:15:48.953 p.m.	-76.884812	-12.015563	Wams::CsfbStarts	
8	09/04/2015 07:16:31.389 p.m.	-76.885116	-12.015535	Wams::CsfbCompletes	Last csfb test status = Successful
9	09/04/2015 07:16:42.018 p.m.	-76.885175	-12.015498	Wams::CsfbStarts	
10	09/04/2015 07:17:24.484 p.m.	-76.885046	-12.015694	Wams::CsfbCompletes	Last csfb test status = Successful
11	09/04/2015 07:17:33.835 p.m.	-76.885002	-12.015632	Wams::CsfbStarts	
12	09/04/2015 07:18:17.145 p.m.	-76.885164	-12.015392	Wams::CsfbCompletes	Last csfb test status = Successful
13	09/04/2015 07:18:27.901 p.m.	-76.885096	-12.015373	Wams::CsfbStarts	
14	09/04/2015 07:19:10.844 p.m.	-76.885174	-12.015257	Wams::CsfbCompletes	Last csfb test status = Successful
15	09/04/2015 10:04:28.416 p.m.	-76.885889	-12.015949	Wams::CsfbStarts	
16	09/04/2015 10:05:11.714 p.m.	-76.885927	-12.015794	Wams::CsfbCompletes	Last csfb test status = Successful
17	09/04/2015 10:05:21.900 p.m.	-76.885857	-12.015751	Wams::CsfbStarts	
18	09/04/2015 10:06:05.089 p.m.	-76.885739	-12.015620	Wams::CsfbCompletes	Last csfb test status = Successful
19	09/04/2015 10:06:14.813 p.m.	-76.885742	-12.015576	Wams::CsfbStarts	
20	09/04/2015 10:06:57.211 p.m.	-76.885567	-12.015310	Wams::CsfbCompletes	Last csfb test status = Successful
21	09/04/2015 10:07:07.955 p.m.	-76.885513	-12.015228	Wams::CsfbStarts	
22	09/04/2015 10:07:51.684 p.m.	-76.885385	-12.015023	Wams::CsfbCompletes	Last csfb test status = Successful
23	09/04/2015 10:08:00.822 p.m.	-76.885351	-12.015005	Wams::CsfbStarts	
24	09/04/2015 10:08:44.635 p.m.	-76.885024	-12.014880	Wams::CsfbCompletes	Last csfb test status = Successful
25	09/04/2015 10:08:54.964 p.m.	-76.884990	-12.014819	Wams::CsfbStarts	
26	09/04/2015 10:09:37.449 p.m.	-76.885177	-12.015040	Wams::CsfbCompletes	Last csfb test status = Successful
27	09/04/2015 10:09:47.885 p.m.	-76.885243	-12.014886	Wams::CsfbStarts	
28	09/04/2015 10:10:30.348 p.m.	-76.885246	-12.014708	Wams::CsfbCompletes	Last csfb test status = Successful
29	09/04/2015 10:10:39.867 p.m.	-76.885253	-12.014722	Wams::CsfbStarts	
30	09/04/2015 10:11:29.186 p.m.	-76.885151	-12.014442	Wams::CsfbCompletes	Last csfb test status = Successful

FIGURA 6-1: EVENTOS EN LLAMADA CSFB EN PISO 1

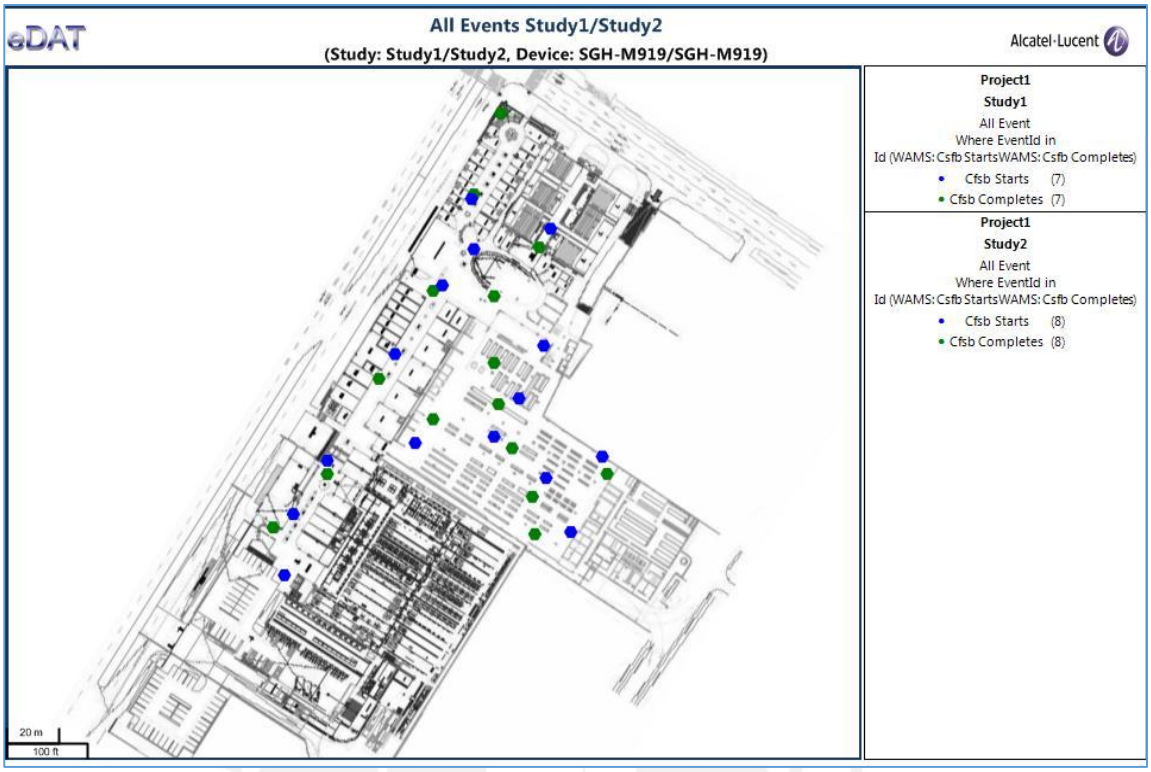


FIGURA 6-2: EVENTOS EN LLAMADA CSFB EN PISO 1 - PLANO

- **Piso 1 - *Mezzanine***

Para el piso 1 - *Mezzanine* se hicieron 3 llamadas en 4G-LTE. El siguiente gráfico muestra los 3 intentos de llamada y los 3 resultados que se obtuvieron.

Se aprecia que de los 3 intentos realizados los 3 fueron exitosos, teniendo una tasa de éxito del 100%.

All Events Study1 | All Events Study1 ×

All of 6	Timestamp	Longit	Latitu	All Even....EventId	All Event.Val...dditionalInfo
1	29/04/2015 07:56:46.677 p.m.	-76.884596	-12.015946	Wams::CsfbStarts	
2	29/04/2015 07:57:30.750 p.m.	-76.884714	-12.015946	Wams::CsfbCompletes	Last csfb test status = Successful
3	29/04/2015 07:57:40.930 p.m.	-76.884729	-12.015962	Wams::CsfbStarts	
4	29/04/2015 07:58:23.913 p.m.	-76.884825	-12.015877	Wams::CsfbCompletes	Last csfb test status = Successful
5	29/04/2015 07:58:34.019 p.m.	-76.884827	-12.015887	Wams::CsfbStarts	
6	29/04/2015 07:59:16.459 p.m.	-76.884766	-12.015889	Wams::CsfbCompletes	Last csfb test status = Successful

FIGURA 6-3: EVENTOS EN LLAMADA CSFB EN MEZZANINE

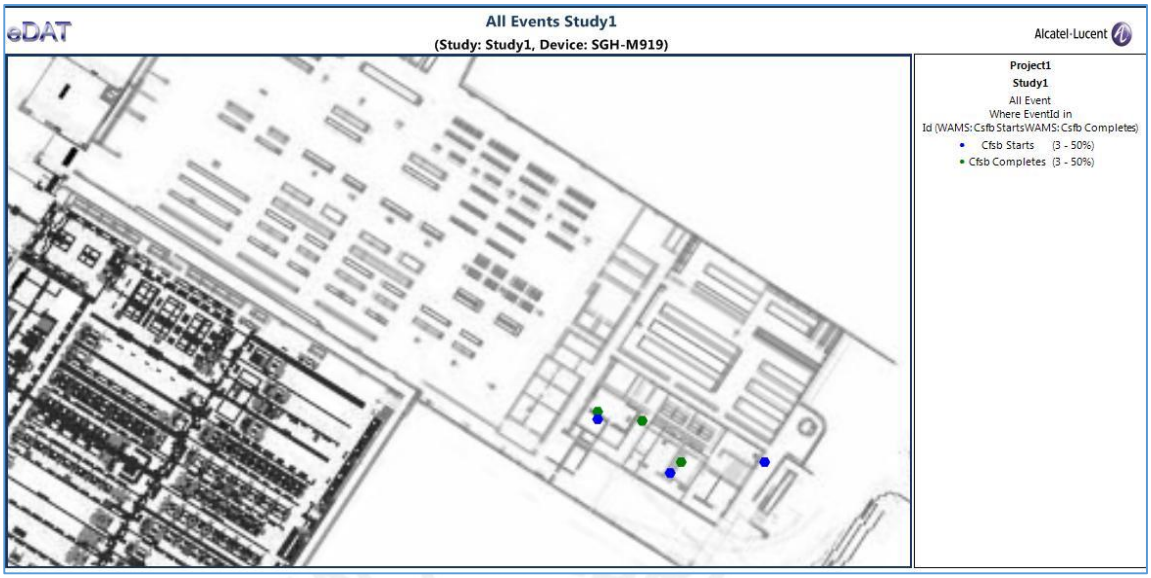


FIGURA 6-4: EVENTOS EN LLAMADA CSFB EN MEZZANINE - PLANO

- **Azotea**

Para la Azotea se hicieron 3 llamadas en 4G-LTE. El siguiente gráfico muestra los 3 intentos de llamada y los 3 resultados que se obtuvieron.

Se aprecia que de los 3 intentos realizados los 3 fueron exitosos, teniendo una tasa de éxito del 100%.

All Events Study1

All of 6	Timestamp	Long	Lati	All Even....EventId	All Event.Val...dditionalInfo
1	05/08/2015 20:34:00.130	1.000299	1.000141	Wams::CsfbStarts	
2	05/08/2015 20:34:45.671	1.000303	1.000134	Wams::CsfbCompletes	Last csfb test status = Successful
3	05/08/2015 20:34:54.994	1.000305	1.000134	Wams::CsfbStarts	
4	05/08/2015 20:35:38.766	1.000313	1.000134	Wams::CsfbCompletes	Last csfb test status = Successful
5	05/08/2015 20:35:49.003	1.000315	1.000134	Wams::CsfbStarts	
6	05/08/2015 20:36:32.766	1.000321	1.000134	Wams::CsfbCompletes	Last csfb test status = Successful

FIGURA 6-5: EVENTOS EN LLAMADA CSFB EN AZOTEA

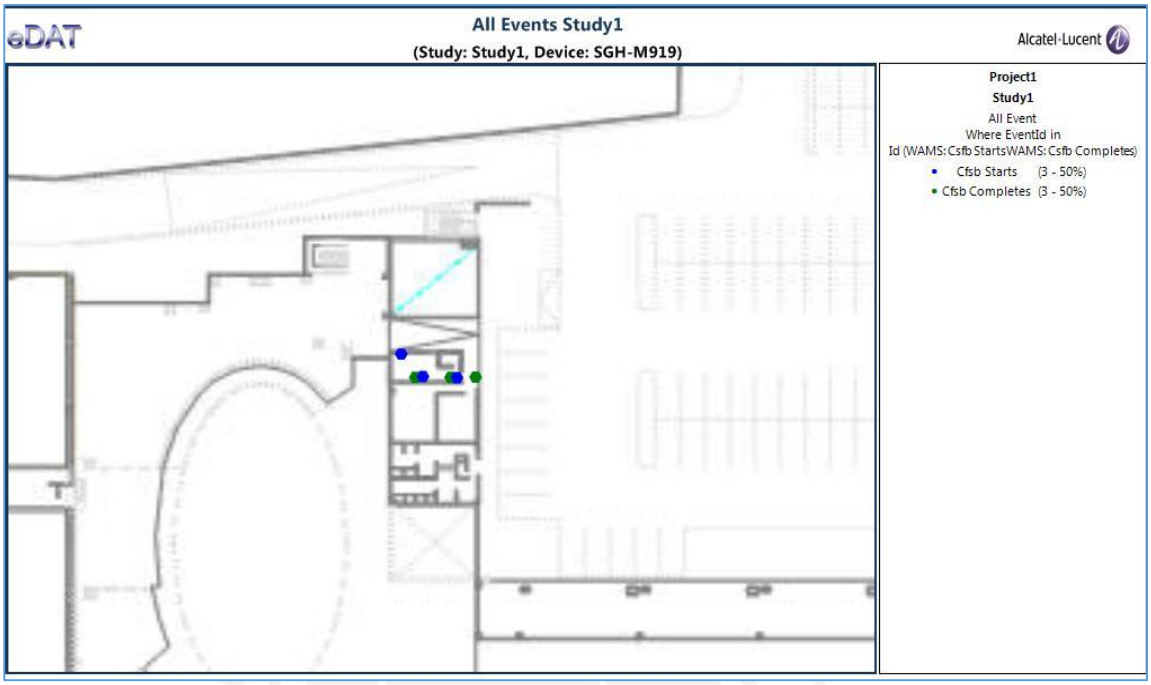


FIGURA 6-6: EVENTOS EN LLAMADA CSFB EN AZOTEA

- **KPI de 3G**

1. **RSCP**

- **Piso 1**

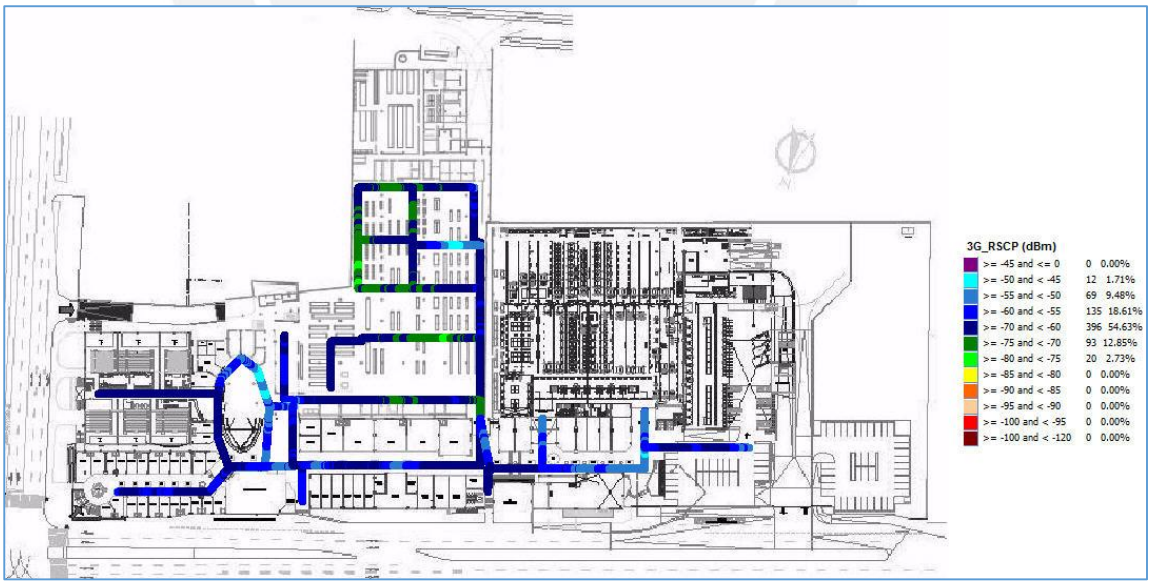


FIGURA 1-1: MEDICIÓN DE RSCP EN PISO 1

- **Piso 1 - *Mezzanine***

FIGURA 1-2: MEDICIÓN DE RSCP EN PISO 1 – *MEZZANINE*

- **Azotea**

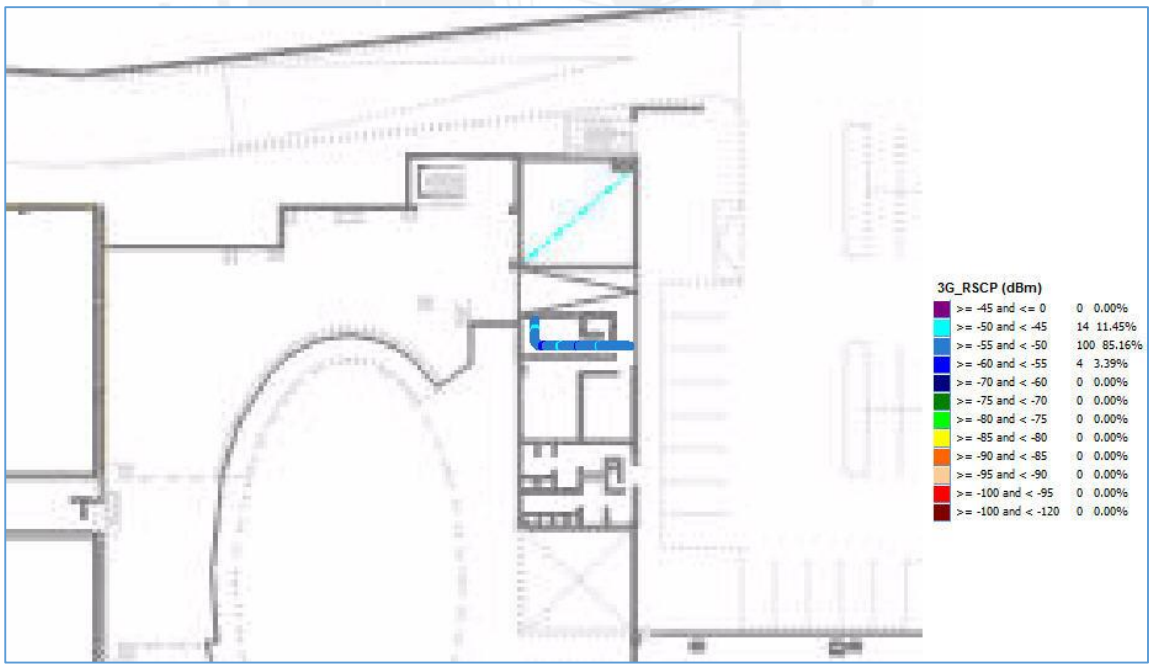


FIGURA 1-3: MEDICIÓN DE RSCP EN AZOTEA

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSCP (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	0	0.00%	97.24%
-50 to -45	12	1.66%	
-55 to -50	69	9.52%	
-60 to -55	135	18.62%	
-70 to -60	396	54.62%	
-75 to -70	93	12.83%	
-80 to -75	20	2.76%	2.76%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

MEZANINE			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSCP (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	0	0.00%	100.00%
-50 to -45	1	0.55%	
-55 to -50	18	9.89%	
-60 to -55	52	28.57%	
-70 to -60	111	60.99%	
-75 to -70	0	0.00%	
-80 to -75	0	0.00%	0.00%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

AZOTEA			
% de muestras dentro del rango aceptable que piden las operadoras			95%
RSCP (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	0	0.00%	100.00%
-50 to -45	14	11.86%	
-55 to -50	100	84.75%	
-60 to -55	4	3.39%	
-70 to -60	0	0.00%	
-75 to -70	0	0.00%	
-80 to -75	0	0.00%	0.00%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

TOTAL			
RSCP (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	0	0.00%	98.05%
-50 to -45	27	2.63%	
-55 to -50	187	18.24%	
-60 to -55	191	18.63%	
-70 to -60	507	49.46%	
-75 to -70	93	9.07%	
-80 to -75	20	1.95%	1.95%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

FIGURA 1-4: CUADRO PORCENTUAL GENERAL

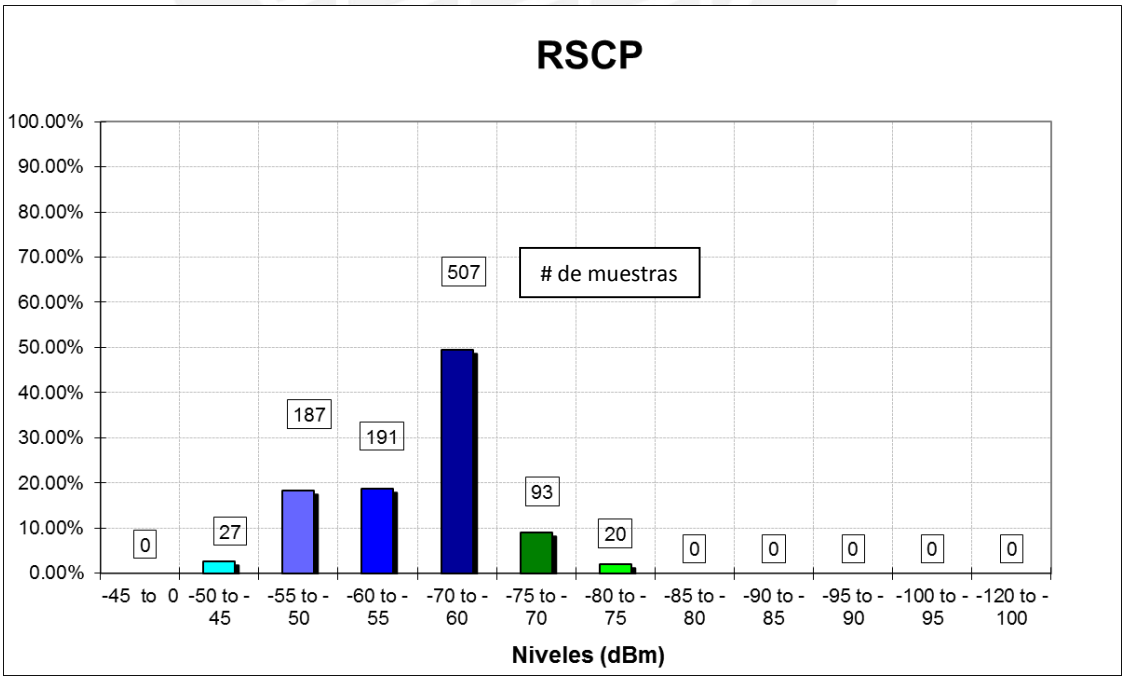


FIGURA 1-5: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 95% de las muestras de RSCP obtenidas dentro del rango RSCP>= -75dBm. Como se observa, se obtuvo el 98.05% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

- **KPI de 2G**

1. **RX *LEVEL***

- **Piso 1**

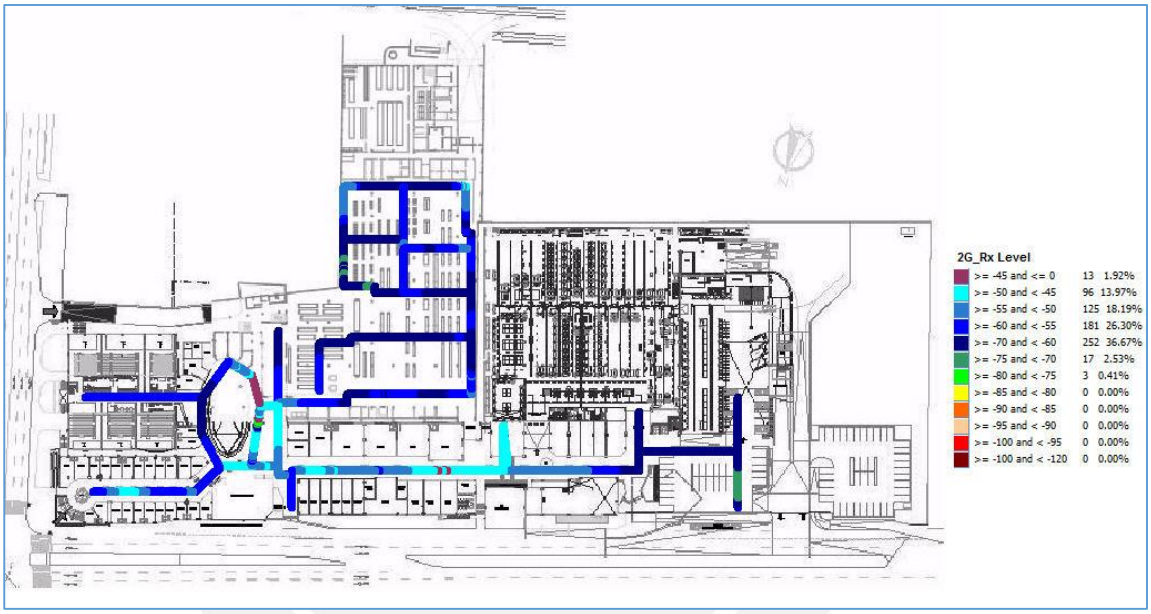


FIGURA 1-1: MEDICIÓN DE RX LEVEL EN PISO 1

PISO 1			
% de muestras dentro del rango aceptable que piden las operadoras			95%
Rx Level (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	13	1.89%	99.56%
-50 to -45	96	13.97%	
-55 to -50	125	18.20%	
-60 to -55	181	26.35%	
-70 to -60	252	36.68%	
-75 to -70	17	2.47%	
-80 to -75	3	0.44%	0.44%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

TOTAL			
Rx Level (dBm)	# Muestras	Porcentaje	KPI
-45 to 0	13	1.89%	99.56%
-50 to -45	96	13.97%	
-55 to -50	125	18.20%	
-60 to -55	181	26.35%	
-70 to -60	252	36.68%	
-75 to -70	17	2.47%	
-80 to -75	3	0.44%	0.44%
-85 to -80	0	0.00%	
-90 to -85	0	0.00%	
-95 to -90	0	0.00%	
-100 to -95	0	0.00%	
-120 to -100	0	0.00%	

FIGURA 1-2: CUADRO PORCENTUAL GENERAL

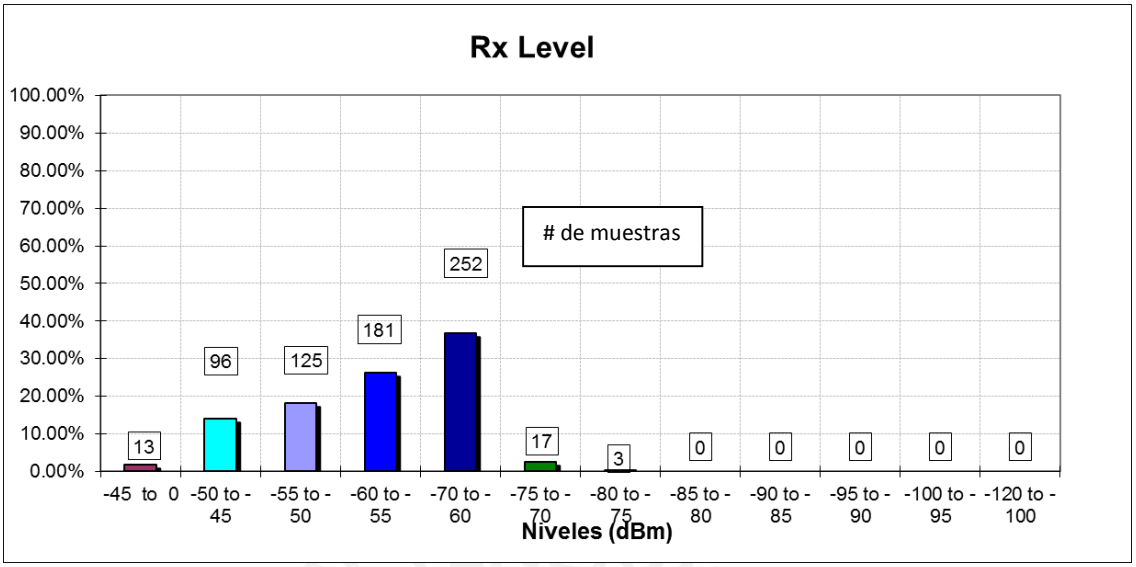


FIGURA 1-3: CUADRO ESTADÍSTICO TOTAL

Las operadoras piden que la red *indoor* presente al menos el 95% de las muestras de Rx *Level* obtenidas dentro del rango RxLev >= -75dBm. Como se observa, se obtuvo el 99.56% de las muestras totales dentro del rango aceptable superando el porcentaje solicitado por el operador.

- ***OUTDOOR***

Se muestra el siguiente gráfico donde se observa si el sistema *indoor* afecta o no a la red *outdoor*. Las mediciones se obtuvieron alrededor de la cuadra del centro comercial.

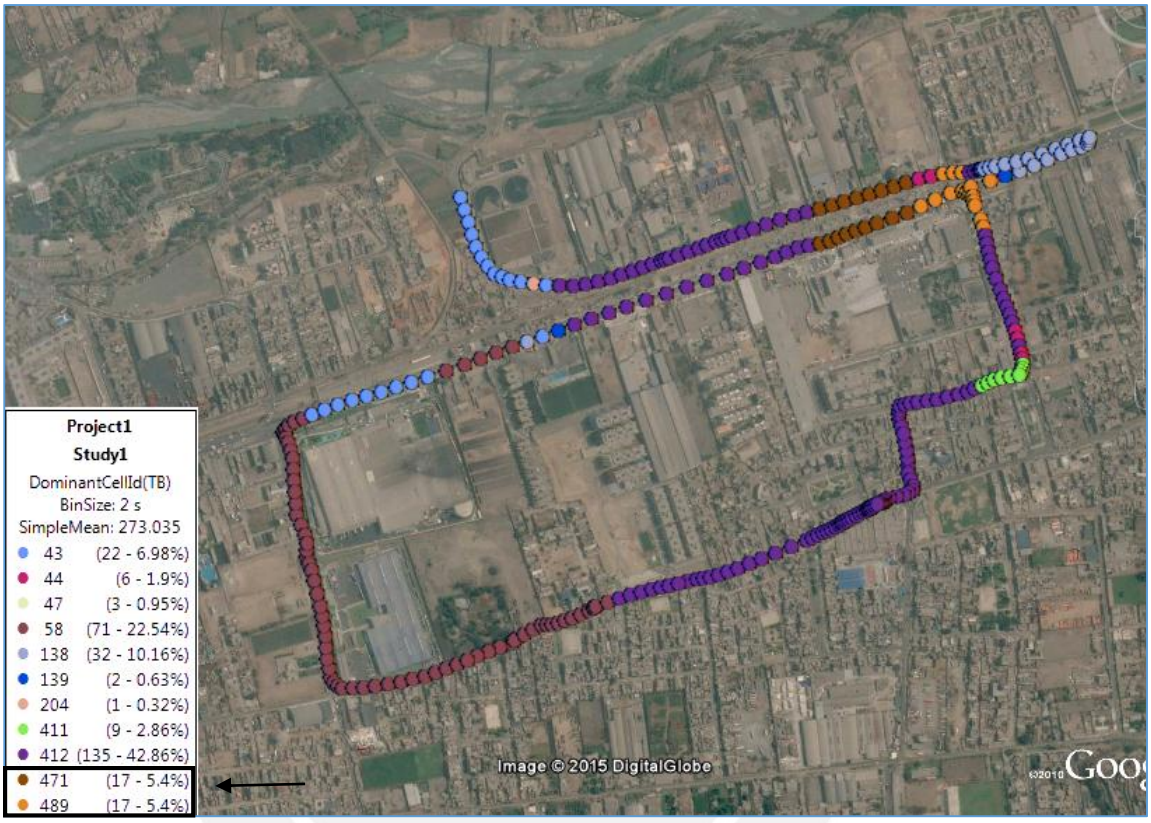


FIGURA 1-1: MEDICIÓN EN EXTERIORES

Se puede observar la presencia de los ID 471 y 489 que corresponden a los sectores 2 y 1 respectivamente. Lo ideal sería que no se obtenga presencia de los sectores *indoor* en la red *outdoor*. Esto puede resolverse bajando la potencia a los sectores *indoor* mencionados; este proceso de ajustes se da en la etapa de optimización.

Por último se muestra el resumen de los principales KPI para el sistema instalado.

N° Piso	RSRP	RSRQ	Throughput (DL)	SNIR	Best Server	RSCP	Rx LEVEL
	95.00%	95.00%	90.00%	95.00%	99.00%	95.00%	95.00%
	>= -90dBm	>= -10dB	>= 25Mbps	>= 20dB	>=	>= -75dBm	>= -75dBm
Azotea	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	-
P1 Mezamine	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	-
P1	99.73%	100.00%	97.27%	95.95%	100.00%	97.24%	99.56%
TOTAL	99.78%	100.00%	97.69%	96.69%	100.00%	98.05%	99.56%

FIGURA 1-2: RESUMEN DE KPI